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REPORT OF THE WORKERS' HEALTH STUDY
OF THE UPPER OTTAWA STREET
LANDFILL SITE STUDY

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SUMMARY

This report describes the design and conduct of a retrospective (historical prospective) morbidity survey of a cohort of workers from the Upper Ottawa Street Landfill Site in Hamilton, Ontario. The objectives of the research were to generate health problem hypotheses for a residents' health study; to describe the current and past health problems of the workers who worked at the site during and after the time liquid industrial waste was deposited there; and to identify excesses in morbidity (and mortality) among workers which might be associated with these exposures. The study involved an interviewer administered health questionnaire, followed by assessment of recall bias through medical chart abstraction. Data was analyzed for evidence of strength of association between specific health problems and landfill site exposure; evidence of recall bias; clustering of onset of health problems during peak dumping periods; risk gradient by "intensity" of exposure; and biologic plausibility. The health problems associated with landfill site exposure were graded by credibility of association. Those with the highest overall credibility were chronic bronchitis, daily cough, combined respiratory problems, "narcotic" symptoms and mood disorders. An intermediate level of credibility was evident with difficulty breathing, skin rash, combined skin problems, and muscle weakness in arms and legs. The results of this study permitted the Study Committee to identify, as hypotheses, 19 individual adult health problem items from the residents' health survey, which followed from these conditions. These hypotheses will be tested as part of the analysis of the residents' study. While the results of the workers' study increase the probability that health problems have resulted from exposure to landfill site emissions, conclusions relevant to policy discussions await the results of the residents' study. The question of doing follow-up studies using clinical or pathologic markers, will be addressed when the residents' study is completed.

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WORKERS' STUDY REPORT

I. INTRODUCTION

This report describes the design and conduct of a retrospective (historical prospective) morbidity survey of a cohort of workers from the Upper Ottawa Street Landfill Site in Hamilton, Ontario. The study compared the self-reported health histories of those working at or near the Landfill site between 1965 and the present with a sample of City and Municipal workers working at other outdoor occupations during the same time period. In addition, the mortality experience of the exposed cohort was compared with that of all Ontario males in standardized and proportional mortality analyses. The objectives of this research were threefold:

1. To generate hypotheses regarding possible health effects from exposure to the landfill which could be used in the design and analysis of a study of residents' health.

2. To describe the current and past health problems of the workers who worked at the Upper Ottawa Street Landfill Site during and after the time that liquid industrial waste was disposed of there.

3. To identify excesses in morbidity and mortality among the workers which might be associated with exposure to wastes disposed of at the landfill.

II. BACKGROUND

The Upper Ottawa Street Landfill Site is located near the slope of the Niagara Escarpment in Hamilton, Ontario (Figure 1). It began as a rural quarry dumpsite in the 1950's, situated on a permeable fractured bedrock of dolomite, shale, siltstone, and limestone. Now it is a 90 foot high garbage mound covering about 40 acres. It is bordered on the north side by the Red Hill Creek. Houses were built to within 500 metres on the west and north sides during the 1970's. To the east is a conservation area and a light industrial park is located across the street on the south side.

From the early 1950's until it was closed in 1980, the Upper Ottawa Street Landfill Site received all types of domestic and commercial waste as well as solid and liquid industrial wastes.[1] By the mid-1960's, as much as 5 truck loads a day of industrial waste was being received by the landfill. However, the annual tonnage increased markedly during the 1970's. Available records suggest that approximately 225,000 gallons of liquid wastes were disposed of in the site in 1970. It would appear that larger volumes of liquid waste began entering the landfill in 1976 with the opening of a solidification operation. According to records, the largest volumes of liquid wastes appear to have been disposed of during 1978: approximately 8 to 12 million gallons.[2] The site was closed to landfilling in 1980. In late 1980, it was covered by a layer of steel industry wastes, consisting primarily of flyash, and ranging from a depth of up to 20 feet on the flat top of the landfill to only a few feet on the steep slopes.

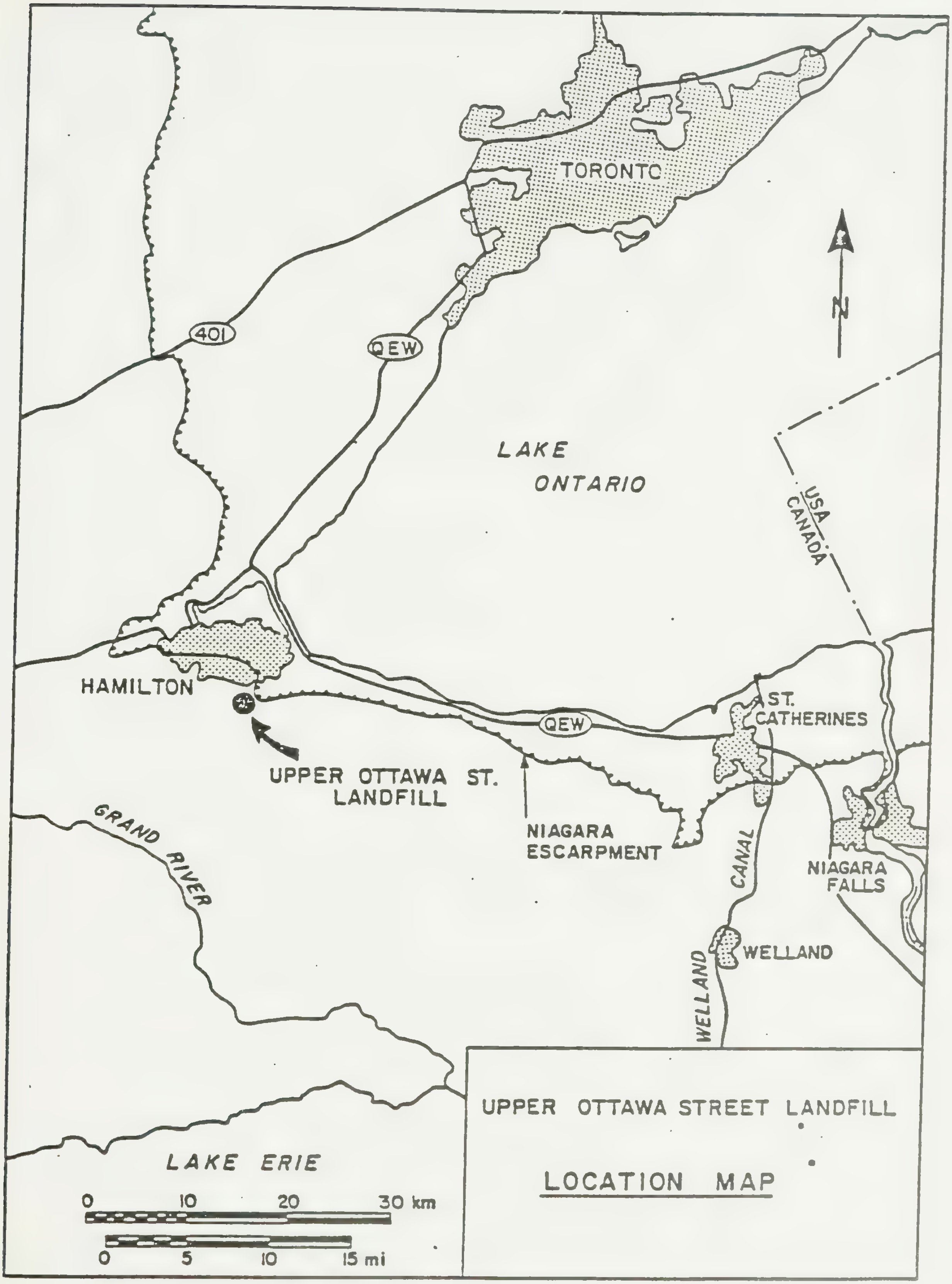

Figure 1. Location of the Upper Ottawa Street Landfill

The possibility of adverse health effects resulting from exposure to the Upper Ottawa Street Landfill Site was raised publicly in 1978,[3] when residents of the adjacent subdivision began to draw parallels between the Love Canal experience and their own. In 1979, an informal survey of health effects among the residents was carried out by some of the organizers of the residents' group.[4](see Appendix e) It was suggested that there were excesses of sore throats, colds, headaches, earaches, "bleeding" and "kidney problems" among the residents when compared to a control survey. These results received widespread criticism as being unscientific because of the way in which the survey was conducted and the enormous potential for bias intrinsic to a special interest group studying itself.

In October, 1980, the Ministry of Health announced that it would fund an investigation of the Upper Ottawa Street Landfill Site, as requested by the Regional Municipality of Hamilton-Wentworth.[5] An Upper Ottawa Street Landfill Site Study Committee was established with three terms of reference. These include:

1. To investigate the validity of studying, and, as appropriate, to recommend to the Minsiter of Health that studies be undertaken on:
    (a) the chemical nature of the materials deposited in the landfill site and their changes in that environment;
    (b) the migration of chemical substances away from the area;

    and to consider the findings of any such studies.

2. To advise the Minister as to the Committee's findings and as to the possible existence at or about the landfill site of a hazard to human health.

3. To consider such other matters brought out in the course of the Committee's activities which the Committee deems relevant to the terms of reference.[6]

The Committee began its investigation in April of 1981 by formulating a sequential study approach. This consisted of efforts to:

1. determine from records what was buried in the landfill itself,
2. examine the environment around the landfill for chemicals, and
3. examine the health of workers and residents to determine what ill health effects, if any, might be attributable to exposure to landfill chemicals. The Committee recognized that the investigation was the first of its kind in Ontario and would be viewed as a prototype with application to problems at other landfills in the future.

The Committee and its Advisory Health Group decided that a health study of landfill workers should precede the resident's health study. The reasons for this were:

1. The workers represented a potentially high dose exposure subgroup, and might therefore be particularly susceptible to any potential health impact associated with exposure to the landfill.

2. Apparent increases in specific morbidity found in a workers' study could receive special attention in the residents' study, thereby reducing the multiple comparisons problem inherent in the analysis of a general morbidity survey.

3. Consistent results from two separate health surveys with different designs might be more credible than one study which tried to combine workers and residents in one protocol.

The Committee recognized that neither a resident nor worker health study would be straight-forward. There was an absence of scientific papers in the refereed literature concerning the methodology and conduct of similar studies at other landfill sites. The complex toxicological nature of the landfill and the subjective nature of the residents' initial complaints made it difficult to identify a short-list of health problems of particular interest. There were great opportunities for bias due to the complex political nature of the problem. But none of these difficulties precluded the design and execution of studies which could indicate the possible existence of human health hazards at or about the landfill.

III. LITERATURE REVIEW

The morbidity survey, based on self-reports of individuals living and working near liquid waste disposal facilities, has become an important element in the investigation of the health status of exposed populations.[7,8,9] Comparison of health status has sometimes been made with matched controls from nation wide health data,[7] but usually with local, unexposed control groups.[8,9] Such surveys have caused concern within the scientific community regarding the interpretation of both positive and negative findings.[10,11] Some investigators have argued that epidemiologic surveys cannot help define etiologic associations in relation to liquid waste disposal unless certain preconditions are met. These have been summarized separately by Landrigan [10] and Heath, [11] and are paraphrased below.

1. The nature and quantities of the major environmental emissions from the site should be known.

2. The probable routes of human exposure (transcutaneous, inhalation, or ingestion) should be defined.

3. Individual exposure estimates should be defineable or biologic assessments of absorption conducted.

4. High risk subpopulations should be defined prior to study.

5. Specific and sensitive health outcome indicators should be utilized.

These conditions present the epidemiologist with a dilemma, since each depends upon the existence of excellent quality exposure information, best collected prospectively, from landfill site records, air monitoring surveys, hydrogeological surveys, and soil analysis.

Such information was not routinely collected at the Upper Ottawa Street Landfill Site or at any of the other liquid waste facilities from the post-war period which have come to public prominence in recent years.

In the absence of prospective data collection, concurrent analysis of the landfill contents, hydrogeological surveys, or scrutiny of the waste production records of companies using the landfill might help reconstruct exposures. Where sites were owned or operated for the use of specific companies or industries, this process might be successful in identifying specific substances with known toxicities, from which target health problem hypotheses could be generated.[7] However, when a site was used for multi-source dumping, indeterminate quantities of large numbers of chemicals will likely be identified. In such a case, specific causative hypotheses may be harder to generate [12] and the conditions for epidemiologic study identifed by Landrigan[10] and Heath[11] may not be met. Does this mean that health studies should not be carried out? Certainly not. Failure to meet these conditions does not reduce public concern regarding possible health effects, and the potential is great for a conflict between public perceptions and scientific needs. Levine[13] has documented the negative psychosocial impact among residents in reaction to traditional scientific behaviour from decision-makers during the Love Canal crisis. Her observations pose a challenge to the epidemiologist investigating the potential health impact of a toxic waste disposal facility. Should the usual scientific standards of technical precision and cautious interpretation be strictly maintained or should a pragmatic approach be taken which seeks to provide the best documentation of health status possible under the contraints imposed by the situation? This investigation is based on the latter philosophy.

When high-quality exposure information is unavailable, investigators must usually settle for using duration of residence and proximity to landfill site information instead of personal estimates of chemical-specific exposure, [9] while resorting to non-specific environmental health indicators as outcome measures. [7,8,9,12] While these compromises reduce the validity of an epidemiologic survey, they focus attention on different study design issues. In particular, selection of the most appropriate non-specific health indicators and strategies to avoid subject recall biases are the challenges which can be addressed within these constraints.

Suggestions for appropriate non-specific health indicators include both clinical and pathologic outcomes. Among the clinical outcomes, reproductive and developmental effects, [8, 12] cancer,[12] respiratory and skin problems,[7, 8, 9]irritant symptoms,[7,8,9], and neuropsychological deficits[8, 14] have received the most attention. Each group of outcomes has both advantages and disadvantages. Some of these are outlined in Table 1. In general, those health problems which are long-term, most serious, or potentially most clinically distinct may be too rare to achieve acceptable study power, since populations exposed to landfills, unlike occupational cohorts, often include few long-term or high-dose individuals. [10] Studies which confine themselves to such outcomes will therefore be uninterpretable if they give negative results. Studies confined to common respiratory, irritant, dermal, or neuropsychological problems will tend to lack credibility if they are positive, since recall biases, the health effects of lifestyles and occupation, and problems with the reliability and biologic relevance of symptom histories will threaten such studies' overall validity.

Surveying markers of environmental pathology has been raised as a theoretical solution to the difficulties posed by clinical

TABLE 1: Environmental Health Outcomes

Non-specific Clinical Outcome	Advantages	Disadvantages
1. Reproductive Problems	May represent serious long-term health problems; some events are easily distinguished as unusual or special.	Important events may be rare; historical records may be poor; control selection will be difficult.
2. Developmental Problems	May represent serious long-term health problems.	Important events may be rare and difficult to observe.
3. Cancer	Serious health problem: diagnostic information may be available.	Rare; latent period requirements may not be met by a sufficient proportion of the exposed population.
4. Repiratory and skin problems	Common, of immediate concern to exposed populations.	Poor documentation available for self-limiting conditions; recall may be selective; distinct clinical syndromes may be difficult to define; other lifestyle and occupational factors may be more important.
5. Irritant symptoms	as in # 3	as in # 3
6. Neuropsychological disorders	Some clinical instruments available; of immediate concern to exposed populations.	Difficult to separate symptoms related to anxieties about living near a landfill from toxic effects of the landfill.

markers. Suggested markers may be grouped by pathologic process and organ-system (measures of mutagenesis,[12] neurotoxicity,[14] hepatotoxicity,[15]), or by exposure (for instance, metal toxicity[16,17]). Could such markers solve the study power problem related to chronic disease outcomes and also the credibility problem related to symptom histories? If markers of exposure-specific, chronic disease were able to identify a larger at risk subpopulation than that with the disease itself, the problem of low study power would be mitigated. (For instance, B-2-microglobulinuria might identify the at risk population for cadmium nephropathy.[16]) With respect to symptom histories, sensitive markers might be able to distinguish self-reports which could be attributable to the exposures of interest from those related to other factors.

The difficulties of using pathological markers may be illustrated by the recent study of cytogenetic findings from Love Canal.[18] In that case, the utilization of sister chromatid exchange failed to provide a credible assessment of risk because the positive and negative predictive value of the test were not known and the clinical implications of the test result itself were not well understood.

The use of pathological markers was not initially considered in the Upper Ottawa Street Landfill Site Study because no exposure-related hypotheses were sufficiently well defined to make their use feasible. Effort was made to maximize the validity of the health questionnaire survey by a series of strategies which are detailed in the materials and methods sections of this report. In brief, these strategies included:

1. a review of environmental health questionnaires used elsewhere to identify the best content and phraseology from previous experience.

2. organizing the main health items in a comprehensive organ-system review format to disguise items which are of specific relevance to environmental health. Inclusion of health items which were not thought to be related to environmental exposure was similar to the inclusion by Spitzer[19] of decoy questions in his study of the health status of residents of the Junction Triangle.

3. including items from the Canada Health Survey,[20] so that comparisons could be made with "benchmark" data.

4. carrying out a comprehensive review of study subjects' family physician charts to assess any recall biases between exposed workers and controls.

IV MATERIALS AND METHODS

a) Study Subjects

Through discussion with former landfill site employees, a consensus was reached that daily disposal of liquid industrial waste began in the mid-1960's. For this reason, 1965 was identified as the year of first exposure, and the entry year for study subjects. The Region of Hamilton-Wentworth provided the study committee with names of 20 former landfill employees and 16 licensed salvage pickers, as a starting point for cohort identification. These were primarily long-term workers who had been at the site when management changed hands from the City of Hamilton to the Region of Hamilton-Wentworth in the early 1970's. Neither government kept employee records for landfill site workers which would have allowed systematic identification of a cohort in retrospect. Through telephone contact with these individuals, we were able to identify the names of other

workers and descriptions of other occupations involving landfill site exposure. In all, four broad occupational groups were defined as exposed: landfill site employees of the Region of Hamilton-Wentworth, landfill site employees of the City of Hamilton, salvage pickers, and firefighters who were periodically stationed at a nearby training facility. Regional employees included all those responsible for the direct supervision of the landfill, including scalemen, security guards, heavy machinery operators, waste testers, liquid waste solidification plant attendants, and supervisors. Most of these jobs ended with the closing of the site in 1980. As well, regional sewer and water works personnel had on-site storage facilities at the landfill. These were still used after the site was closed until 1983. City employees included all those who worked out of a works yard adjacent to the landfill and garbage men who unloaded at the landfill several times a day. Salvage pickers were licensed to follow garbage trucks onto the landfill and recover paper, metal and wood directly from the dump face. Firefighter instructors work seasonally at a firefighter training centre which is also adjacent to the landfill. In general, Regional employees and salvage pickers were potentially exposed through airborne contact and direct cutaneous exposure, while City employees and firefighters were potentially exposed through airborne contact only.

All names supplied by telephone contact were checked against Regional and City personnel records, and other names with similar job descriptions were added to the list. Additional salvage picker names were confirmed by direct telephone contact or agreement by two or more salvage pickers that an individual had worked at the landfill. Firefighter names were supplied by supervisory personnel. This iterative approach created a cohort of 176 live and 21 deceased workers. Cohort identification was terminated when new leads stopped coming to us through our contacts. Because of the lack of systematic record keeping of workers exposed to the landfill site, we cannot be

assured that the cohort was complete. It is likely that some short-term workers were missed, but unlikely that many long-term workers remained unidentified. Eight other names supplied to us were ineligible because occupational status could not be confirmed (6) or because the individuals were no longer their own legal guardian (2). The composition of the cohort by broad occupational group is shown below in Table 2. It is interesting to note that 32 percent of the salvage pickers had died by the time of the study, compared to 8 percent of the other study subjects. This would appear to reflect their age distribution.

TABLE 2 - COMPOSITION OF THE EXPOSED COHORT

Occupational Group	Alive	Dead	Total
Regional employees	61	5	66
City employees	93	9	102
Salvage pickers	15	7	22
Firefighters	7	-	7
TOTAL	176	21	197

Workers were targeted for a questionnaire interview; next-of-kin interviews were not conducted on behalf of the deceased workers. The methodologic problems involved in combining next-of-kin with first-hand health reports and the ethical problems associated with contacting and interviewing next-of-kin were seen as major obstacles. Instead, death certificate information was obtained from the Provincial Registry and analyzed using both PMR and SMR methods (Table 20). The issue of conducting next-of-kin interviews was originally set aside for reconsideration if analysis of the morbidity survey were to have shown excesses of life-threatening morbidity which might be

related to the cause of death among the deceased. In the absence of excesses of life-threatening morbidity, it was felt that the methodologic problems with conducting next-of-kin interviews outweighed the benefits of a more "complete" morbidity survey.

(b) Controls

The City of Hamilton and four other municipalities within the Region of Hamilton Wentworth provided the study team with names of all outdoor workers with no known landfill site exposure or regular exposure to herbicides and pesticides. The four outlying municipalities also supplied names of retired outdoor workers. Delays were encountered in receiving the names of former City of Hamilton outdoor workers because of concern over confidentiality. Ultimately, a list of former outdoor workers was compiled by the City of Hamilton Personnel Department, but the study team was not granted permission to approach these individuals directly. A random 1 in 2 sample of the list was identified by the study team and requests for these individuals to contact the investigators were sent out by the City. This approach failed, producing only 8% positive responses. Following the failure of the indirect approach, the study team was given the right to contact the other 50% of the list directly. An adequate response rate was obtained, and these individuals were included in the study.

No independent verification was possible to determine what proportion of former outdoor workers who had quit work but were not receiving pensions had been identified to the study team. We cannot exclude the possibility that such workers would have left the job due

to illness and thus their absence would impose a non-conservative bias on the study results. In all, 235 useable names were supplied.

The control group ultimately consisted of streets and sanitation workers. These persons worked outdoors, as did the exposed group. Employer assignment of workers to landfill or non-landfill work generally occurred after hiring and suitability for outdoor work was determined. Therefore, the control groups likely share with the exposed workers any health-related selection factors that lead to outdoor work. Moreover, the wage scales of the two groups were expected to be similar because of the overlap between collective bargaining units. Because of the heterogeneous nature of the exposed group, and a lack of age information before the questionnaire was administered, one-to-one matching was not feasible. Post-hoc matching was not considered because of the loss of power expected from a large number of unmatchable respondents. This also applied to work histories, where information regarding start dates and specific job details was lacking for both exposed workers and many controls. Self-reported work histories were used throughout this study.

(c) Questionnaire Content

Our initial strategy for questionnaire development was to modify an existing instrument from another environmental health survey. To that end, we evaluated six previously used questionnaires from the United States and Canada *, but were unable to identify an instrument which met our needs. In particular, evidence of validity

* Among those reviewed were: New Brunswick Employee Health Status Survey; Hardeman County, Tennessee questionnaire; New York State Department of Health Love Canal Survey; CDC's Frayser Tennessee questionnaire; and questionnaires from Marvin Legator and Rosalie Bertel.

and reliability was unavailable, content only partially overlapped with the health concerns of our study and questions were often open-ended and therefore not easily quantifiable. We decided instead to use all the available questionnaires as a data bank from which to draw relevant content items which could be rephrased and reformatted to meet our needs. This involved several iterations of the available questionnaires and three groups of health problems of concern:

1. In 1978, the Upper Ottawa Street Residents' Association carried out a health study using a questionnaire designed by the Love Canal Homeowners Association. The following conditions appeared to be more common among landfill residents than a control group: skin rashes, frequent colds, kidney problems, frequent bladder infections, sore throats, headaches and earaches, nervousness, and "bleeding".

2. A summary of the inherent toxic properties of substances tentatively identified in the air, water, and soil at the landfill was prepared for the Upper Ottawa Street Landfill Site Study Committee by Environ Corporation, [21] based on sampling data collected by various consultants to the Committee. [1] More than 100 chemicals were tentatively identified, with a range of inherent toxicities potentially affecting every organ system of the body. (see Appendix f, Table 2) These observations required that the questionnaire contain items relating to each major organ-system.

3. Certain groups of conditions have generally been associated with exposure to toxic industrial substances.

These include:

(a) diseases of the organs which serve as routes of entry of toxic substances to the body. [22] In particular, this means respiratory and skin conditions, and irritant symptoms.

(b) narcotic and anesthetic effects. [22] These related to a wide variety of volatile organic substances and overlap with "neurobehavioural" conditions.

(c) cancer. [23]

(d) reproductive problems [12]

The questionnaire ultimately included the following items (see Appendix 1 for a copy of the questionnaire):

(a) residential characteristics
(b) current sources of drinking water
(c) recent use of health services
(d) disability days*
(e) cigarette and alcohol use*
(f) job history (not including the landfill)
(g) history of exposure to specific toxic substances in non-landfill jobs and hobbies
(h) history of work injuries
(i) socioeconomic status (education, income, ethnic origin, language)
(j) detailed job history at the landfill
(k) reproductive history
(l) presence of long-term health problems (adapted from the Canada Health Survey [10] questions regarding current presence of chronic health problems)*
(m) history of acute and chronic health problems from before 1965 until the date of interview.

*adapted from the Canada Health Survey. [20]

These items divided into four groups: information regarding comparability of study groups (a-i), landfill site exposure (j), health questions for hypothesis generating (k,m) and Canada Health Survey chronic disease questions (l). These latter questions were included so that comparisons could be made between the chronic disease status of the exposed workers and nationally collected data for blue collar workers. (The reasons for this are discussed in the Analysis part of the Materials and Methods section).

Health questions were grouped by organ-system and included many items not thought to be related to environmental exposures. These were included for three reasons:

1. to distract respondents from items of particular relevance
2. to allow respondents to select the best description of their health problems from within a series of related items.
3. to find out whether potential differences in health status were confined to environmentally-related health problems.

Respondents were asked to give the year in which each health problem began, and whether or not it had persisted until the time of interview.

Study power was low with respect to specific cancers and reproductive effects. The maximum time since first exposure was 18 years, which was less than the 20 year latent period often expected in occupational cancer studies. Nonetheless this information was collected as a baseline and in case there was a particularly strong, unsuspected association between a cancer or reproductive problem and exposure to the Upper Ottawa Street Landfill Site.

It was decided that an interviewer administered format would be superior to a telephone interview, because of the potential length and complexity of the questionnaire. Hamilton Opinion Research Centre Limited was awarded the contract to administer the questionnaire, according to a set of criteria described elsewhere. [4] Pre-tests of the questionnaire and the medical chart review consent form were completed on a sample of 13 workers from two other landfill sites in Southern Ontario. These pre-tests resulted in changes in questionnaire logic, flow, sequence, and phraseology, and the consent form was simplified for greater respondent acceptability. The average length of interview was determined to be approximately one and one half hours including the time required to complete consent forms for medical chart abstractions. (see Appendix a, Workers' Health Study Questionnaire.)

d) Questionnaire Administration

The main interviews were conducted in respondents' homes during the spring of 1983 by professional interviewers with experience in conducting interviews involving personally and politically sensitive issues. Because of the method of cohort identification and the publicity surrounding the landfill site, the interviewers could not be kept blind with respect to the repondents' exposure status. Questions regarding work experience at the landfill were confined to the end of the questionnaire to avoid direct discussion of landfill site issues during the interview. However, questions about other jobs and chemical exposures were included in the questionnaire, before the main group of health items. This was done to improve the flow of the interview. Because of our conviction that blindness could not be maintained, considerations of flow in questionnaire administration predominated over attempts to conceal the exposure status of the respondent from the interviewer. Interviewer bias was minimized by

not informing the interviewers of the significance of specific health items. Interviewers were instructed to limit their involvement in the interview process to a specific standardized set of responses when asked for further information by respondents. This further reduced the chances of interviewer bias. Four call-backs were made in order to maximize response rates. Coding, keypunching, and verification were conducted by Hamilton Opinion Research Centre Limited. Test-retest reliability checks were not conducted, in order that study resources be devoted to the medical chart abstraction exercise. (see next section)

After completing each interview, the interviewers were asked to assess the overall level of co-operation of the respondents and record any concerns regarding the nature of the questions. Review of this descriptive information revealed evidence of a high level of co-operation and acceptance of the personal nature of many of the questionnaire items.

e) Medical Chart Abstraction

The records of all family physicians identified by study subjects were examined to confirm self-reported health problems. This was done to measure the reporting bias that might have resulted from the exposed workers' concerns regarding the health impact of working at a liquid industrial waste disposal site. The likelihood of such a bias was increased by the subjective nature of many of the health problems and by the long recall period.

Four experienced nurses employed by Hamilton Opinion Research Centre Limited conducted a pilot study of medical abstraction on 18 respondent charts to help guide the study team in developing reporting instruments and procedures. This exercise demonstrated that it was not feasible to abstract each respondents' medical chart for all 120

health problems in a fashion which would preserve abstractor blindness. The task was too lengthy and called for arbitrary judgements about whether a given report on a medical chart was closer to one or other of our health problem labels. Two feasible approaches were identified:

1. Abstraction could be confined to those health problems reported by each respondent. In this case, abstractors would be unblinded to the health reports of respondents, but would be able to use all their professional skills in evaluating the relationship between the physician records and the individual self-reports.

2. Abstraction could be confined to a randomly-selected list of health problems. In this case, the abstractors could be blinded, but many self-reported health problems would be left unabstracted.

The former approach was used in this study. Abstractor bias was reduced by blinding them to the exposure status of the study subjects. In the residents' study which follows the workers' study, the latter approach was planned.

The pilot study revealed that chart abstraction of all available family physician records would be a feasible approach. At least one specialist consultation note and hospital note was found on the combined family physician charts for each specialist and hospital listed by the respondent on the consent form. This suggested to us that family physician records were comprehensive enough to use in the abstraction study.

Nurse abstractors were required to complete two forms in the family physician's office: a reported condition form and an

unreported condition form. These are included as Appendix (b) and (c) of this report.

The reported condition form contained the following important information:

1. The standard health problem description from the questionnaire for each of the respondents' self-reported conditions.

2. Whether or not the respondent reported seeing a physician for the health problem.

3. The date the respondent first recalled having symptoms related to the health problem.

4. Whether the problem was considered a "symptom" or a "diagnosis" by the study team. The nurse abstractor was required to determine whether the reported health conditions could be confirmed, possibly confirmed, or not confirmed in the physician's chart and to provide evidence for her decision.

The abstractors were given nine descriptions of possible relationships between the information in the medical chart and the self-reported complaint. (Appendix d) Two of the nine descriptions represented "confirmation", four represented "possible confirmation", and three represented "non-confirmation". In addition, they were supplied with an abstractor's manual that gave specific direction regarding how the nine categories were to be applied. The abstractor was required to report each condition by the most appropriate of the 9 categories.

Two situations were defined as representing confirmation (Appendix d). The first was the obvious one where the condition was found essentially verbatim in the chart. The second was where the diagnosis in the chart would necessarily include the symptoms or diagnosis reported by the respondent. For instance, if the respondents reported "headaches" and the chart reported "migraine headaches", this would be an example of a category 2 confirmation.

The "possibly confirmed" categories were developed to fit all the situations in which the distortions and inadequacies of the questionnaire and the abtraction process might have biased the confirmation process toward respondent over-reporting. For instance, category 3 allowed for situations in which a respondent might have reported "shortness of breath" while the chart recorded "chronic bronchitis". In such a case, the respondent might have been most concerned about a symptom which might have been associated with the given diagnosis, but was not necessarily an element of the diagnosis itself. Category 4 was the reverse of category 2. It included situations where the respondent believed he had a disease, but the medical chart only referred to the symptoms associated with the disease and not the disease itself. For instance, if the respondent reported "migraine headaches" and the chart recorded merely "headaches", we could not have been sure that the respondent's reported health problem was absent. Category 5 allowed for situations in which a ruled out diagnosis tended to confirm the respondent's reported symptoms. For instance, a self-report of chest pain may have been affirmed by a statement in the chart that angina had been ruled out. Category 6 allowed for situations in which symptoms or diagnoses could have been inferred from the interpretation of a laboratory test or the fact of the test itself. For instance, a respondent's self-report of angina might have been "possibly confirmed" by a report of an exercise electrocardiogram in the chart, in the absence of any other comments.

Three categories of non-confirmation were included. Categories 7 and 9 were not indications of the respondent's accuracy of recall, but represented shortcomings of the abstraction process. Category 7 covered situations in which the medical chart did not cover the self-reported year of onset of symptoms and category 9 covered unreadable charts. Only category 8 represented over-reporting, in that no diagnoses or symptoms were recorded in the chart which were consistent with or suggestive of the repondent's health problem.

The abstractors were allowed to use their individual judgement in deciding how conflicts between the respondents' reported date of onset of symptoms and the date noted on the chart might affect confirmation status. No fixed rules were applicable. Acute conditions with conflicts in dates of several years or more might fairly be considered completely unrelated events. For chronic conditions, this assumption is much less certain. An individual may have experienced symptoms long before reporting them to a physician or may have recalled a particularly severe episode in a recurring health problem as the time of first onset. In the former case, the respondent's reported date of onset will precede the physician's recorded date. In the latter, it might follow the physician's recorded date.

The reported condition forms were checked for internal consistency between the abstractor's choice of confirmation category and the evidence she provided for her decision. This gave the study team an opportunity to review the way abstractors used date information in choosing confirmation status. Only 5 percent were changed as a result of lack of internal consistency. Changes usually occurred within a broad group, that is, among the four "possibly confirmed" categories or the 2 "confirmed" categories, rather than between these broad groups.

The unreported condition form (Appendix c) provided a listing of 24 categories of health problems taken primarily from the Canada Health Survey. Nurse abstractors were required to record on this form any of the 24 health problems found in medical charts but not directly reported by respondents and not related to a reported health problem used in "possibly confirming" a self-report on the reported condition form.

This approach to chart abstraction allowed us to calculate the proportion of confirmed, possibly confirmed, and non-confirmed among reported conditions and thus, to compare over-reporting between the exposed workers and controls in a search for recall bias. Proportions of under-reported events could not be calculated because the categories on the unreported condition form had to be made broad to include a wide variety of conditions. Thus, validation of reporting in the workers' study is based on possible over-reporting. The approach to medical chart abstraction has been modified for the residents' study so that estimation of over- and under-reporting biases can be made with equal precision.

It is important to note that non-confirmation of a condition did not necessarily mean over-reporting. Inadequate physician record-keeping or communication between specialists and family physicians could have resulted in "apparent" over-reporting. For the purposes of this study, it has been assumed that the quality of record-keeping was equally high among the physicians of each group, so that there would not be a bias imposed by "apparent" over-reporting. If correct, then an analysis of the relative proportions of non-confirmed events would be a valid method to assess recall bias.

It is possible that differences in over-reporting between exposed workers and controls could be masked by a tendency among the

exposed workers to more readily regard themselves as requiring medical attention when they had minor complaints. If the physician recorded these complaints as health problems, then they would be confirmed on chart abstraction and go undetected as over-reporting. This problem is explored later in the report (see Table 28). Abstraction of only those family physician records identified by the respondent might also mask reporting biases. However, it would be unethical to identify and follow-up other physician records without respondent consent. Health insurance data would not serve as a valid surrogate for physician records because of the loss of information when the details of a patient encounter are translated into a brief record for billing purposes.

f) Data Analysis

The strategy for data analysis was as follows:

1. All major sociodemographic variables and other confounders in the data set were compared between exposed workers and controls.

2. All individual health conditions or biologically related clusters of conditions where there was a 50% or greater difference in the incidence (not adjusted for age or follow-up time) between exposed workers and controls, and at least 15 events in total, were deemed to warrant further analysis. No other conditions showed enough events to suggest that age adjustment or adjustment for other confounders would unmask an effect of exposure.

3. The Main Analysis: All biologically plausible confounders, plus age, were included in Cox proportional hazards models [25] for each health condition. The Cox model takes into account the fact that events occur at

different times after initial exposure. That is, a person contributes person-years at risk only from the time of first exposure until the time he experiences the health condition being analyzed. In assessing the main effect of exposure on the rates of various health conditions, it can also control for the influence of possible confounding variables (e.g. age).

Person years at risk were calculated from the year of first exposure at the landfill for all exposed workers. For those who worked there before 1965, 1965 was taken as the first year at risk. Controls' person years at risk began with the first year of the job which qualified them for the control group, or 1965, if they began work before that year. Person years were then counted until the year of interview (1983) regardless of whether or not the individual had left the job. Only first incident events occurring after first exposure to the landfill site or the analogous municipal/city job in the control group were included in the analysis. All events prior to 1965 were excluded. When clusters of health conditions were analysed, only the first eligible incident event within the cluster was counted. Those reporting first events prior to exposure did not contribute person-years to the analysis. Exposures to chemicals and other toxic agents throughout the respondents' working lives were included as potential confounders in appropriate analyses. Many of those exposures occurred before 1965, or the beginning of the job which gained the respondent entry into the study. This, and smoking status, were the only pre-exposure information included in the main analysis. The data was analyzed three ways:

(a) **Analysis 1** - All self-reported events were included

except those where the individual had reported seeing a physician and no evidence of the condition could be found on the physician chart. In such cases, person-years were contributed up to, but not beyond, the date of self-reported illness. Events reported by these refusing chart abstraction were also included.

(b) **Analysis 2** - All other events which were not "confirmed" or "possibly confirmed" on medical chart abstraction were excluded. This meant that information from those refusing chart abstraction, those who did not see a physician, or who saw a physician uncontacted by us, was excluded.

(c) **Analysis 3** - Only those events which were "confirmed" on medical chart abstraction were included.

These 3 analyses allowed the incorporation of data relating to recall bias into the main analysis. Analysis 1 was most statistically powerful but most subject to bias. Analysis 3 was least statistically powerful but least subject to bias.

The cumulative incidence rate of each health problem within the exposed and control group was based on the following ratio:

$$\frac{\textbf{the number of first episodes of the condition since first employment}}{\textbf{the number of person-years without, or prior to the condition, since first employment.}}$$

The relative risk was derived from the exponent of the hazard function in the Cox model. It was related to:

$$\frac{\text{the cumulative incidence rate, given landfill site exposure}}{\text{the cumulative incidence rate, given no landfill exposure}}$$

4. Sub-analyses: Subanalyses of health conditions in step 4 were carried out to assess time-clustering during the peak dumping periods (Table 14), gradient with time since first exposure (Table 15), dose-response gradient by those working directly on-site, adjacent to the site, and controls (Table 16), clustering of symptoms in unique complexes (Table 17), and whether or not health status differences beginning after first exposure persisted to the present (Table 18).

5. Current health status information from step 5 was compared with an analysis of the Canada Health Survey to see whether or not consistent results would have been found if only the Survey questions had been used, and comparison to national "benchmark" data had been made. The details of this comparison will be described in the results section. (Tables 21 and 22).

6. Detailed analysis of the medical chart abstraction data was conducted to assess recall bias. (Tables 23 to 28).

7. Reproductive outcomes (Table 19), work-related injuries (Table 19), and mortality among exposed workers (Table 20) were included in separate analyses.

V. RESULTS

(a) Response Rates

Table 3 presents the interview completion rates for landfill site workers and controls. Although 84.5 percent was an excellent completion rate for the exposed group, only 71.9 percent of the controls were interviewed. This difference was probably due to the fact that the controls had no direct interest in the outcome of the study. While most of the differences in refusal rates were ostensibly for non-health reasons, we could not be sure that a health-related volunteer bias had not occurred.

The consent rates for medical chart abstractions (Table 4) were excellent, with 86.3 percent of eligible exposed workers and 83.8 percent of controls consenting. Table 5 shows the chart abstraction completion rates for those giving consent. At least one useable chart was abstracted for 92.5 percent of consenting exposed workers and 91.5 percent of controls. This high response rate was likely influenced by an excellent working relationship between physicians on the Landfill Site Study Committee and the community physicians whose co-operation was needed.

(b) Comparability of Groups

Evidence of the comparability of the exposed workers and controls is found in Tables 6 to 12. This discussion will consider the information contained in each figure in sequence.

Age Distribution (Table 6) - The mean age of the exposed workers was 49.00 years and of the controls was 47.35 years. This was quite close, given no prior age matching. Retired

TABLE 3: Study Completion Rates

	Cases	Controls
a. Completed Interviews	147	164
b. Refusal (non-health)	24	57
c. Health refusals	3	7
d. Total eligible	174	228
e. Not Available	1	4
f. Could not locate	1	3
g. Total	176	235
COMPLETION RATE (a÷d x 100)	84.5%	71.9%

TABLE 4: Consent Rates for Chart Abstraction

	Exposed	Controls
a. No report of any of the health condition on the questionnaire (consent not needed)	8	22
b. Eligible for consent	139	142
c. Signed consent given	120	119
d. Refused consent	19	23
CONSENTING RATE (c÷b x 100)	86.3%	83.8%

TABLE 6: Age Distribution of Study Subjects

(a) At Interview

	AGE				
	≤ 30	30-49	50-64	65+	Total
Exposed (Mean=49.00)	13	65	50	19	147
Controls (Mean=47.35)	37	46	46	35	164

$x^2_3 = 18.81 \quad p = .003$

$x^2_{linear} = .069 \quad p = .794$

(b) At Entry

	AGE			
	30	30-49	50+	Total
Exposed	40	79	28	147
Controls	66	64	34	164

$x^2_2 = 7.63 \quad p=.022$

$x^2_{linear} = 1.92 \quad p=.166$

controls from the City of Hamilton were sampled from a different list from the other outdoor control workers. As a result, there are proportionately more younger and older workers among the controls and more 'middle aged' workers among the exposed. This is reflected in statistically significant overall differences in age distribution at entry into the cohort and at interview, while the analyses for linear trend were not significant. These observations led to age-adjustment of all health outcomes, regardless of whether they were age-dependent. Age-dependence was only evident in the preliminary analysis of two groups of health conditions of interest (cardiac, arthritis/rheumatism).

Selected Sociodemographic Variables (Table 7) - There were no appreciable between-group differences in national or language background or home ownership. A greater proportion of controls were single, separated, or divorced than exposed workers. Relatively few respondents lived in homes with asbestos or UFFI insulation. But a greater proportion of controls than cases got their drinking water from wells. This reflected the fact that some controls were sampled from rural municipalities within the Hamilton-Wentworth Region. The potential risks of drinking local well water rather than Hamilton drinking water are undocumented. Both of these variables were poorly correlated with most of the target health problems. In addition, a higher proportion of exposed workers were currently married or living common law than controls. This reflected the increased proportion of younger workers among the controls.

Education Status (Table 8) - Educational status did not differ significantly between groups. A tendency towards higher educational status among the exposed workers was not

TABLE 7: Comparability of Exposed and Controls by Selected Sociodemographic Variables

Question		Percentage of Responses: Exposed	(n)	Controls	(n)	$p(x^2)$
1. Country of birth...	Canada	63.3	(93)	72.0	(118)	.101*
	Britain	7.5	(11)	3.7	(6)	
	Other European	27.2	(40)	22.6	(37)	
	Other	2.0	(3)	1.7	(3)	
2. Language first learned ...	English	66.7	(98)	75.6	(124)	.081**
	Italian	15.6	(23)	12.2	(20)	
	German	4.1	(6)	1.8	(3)	
	French	2.7	(4)	1.2	(2)	
	Other	10.9	(16)	9.2	(15)	
3. Current marital status ...	Married or common law	87.1	(128)	70.1	(115)	.0003△
	Separated or divorced	2.7	(4)	7.9	(13)	
	Single	8.2	(12)	16.5	(27)	
	Widowed	2.0	(3)	5.5	(9)	
4. Is the (home/apartment) where you live...owned by you or a member of your household?		76.2	(112)	73.2	(120)	.373
5. Current source of drinking water...	City system	91.8	(135)	78.9	(129)	.0012□
	Well	6.1	(9)	19.5	(32)	
	Other	2.0	(3)	1.8	(3)	
6. In the past 15 years, have you lived in a home that was insulated by either asbestos or urea formaldehyde foam insulation?		3.4	(5)	5.5	(9)	.375

* $x_1^2 = 2.68$, based on Canadian born versus all other

** $x_1^2 = 3.03$, based on English versus all other.

△ $x_1^2 = 13.04$, based on "married or common law" versus all other.

□ $x_1^2 = 10.42$, based on "city system" versus all other.

TABLE 8: Education Status

Level of Education	Percentage of Exposed	(n)	Percentage of Controls	(n)
What is the last grade of school college or university you completed?*				
1. Less than grade 8	18.4	(27)	23.2	(38)
2. Grade 8, 9, or 10	44.9	(66)	36.6	(60)
3. Grade 11 or 12	23.8	(35)	28.0	(46)
4. Grade 13	4.1	(6)	2.4	(4)
5. Some College/university	6.1	(9)	5.5	(9)
6. Completed college/university	2.7	(4)	3.0	(5)
7. refused/don't know	0	(-)	1.2	(2)

* $x_3^2 = 2.95$, $p(x^2) = .40$, based on 4 groups: less than grade 8, grades 8 to 10, grades 11 or 12, and grade 13 or some college/university or completed college/university.

$x_{lin}^2 = .152$, $p(x^2) = .70$, based on linear trend analysis by the same 4 subgroups.

confirmed by statistical analysis for linear trend.

Family Income (Table 9) - A statistically significant trend towards higher income among the exposed workers reflected the inclusion of some employees who had been promoted to professional jobs and fire-fighter senior officers in this group. The modal income range was the same for both groups. Ecological correlation studies relating income to health status in Canada have shown differences in health status between the highest and lowest quintile groups, with decreasing income correlating with decreased health status.[26] The income patterns seen in our study groups do not correspond to differences in income quintile and gave us little cause for concern regarding the comparability of groups by income.

Drinking Habits (Table 10) - The current drinking habits of the two groups were very similar. In particular, the proportion of daily drinkers and total abstainers were almost identical. All the variability was found among those who drank a few times per week to monthly or less. The potential health impact of these differences should be negligible.

Experience with Cigarettes (Table 11) - There were no statisically signficant differences in past and current smoking activity between groups. Non-statistically significant trends toward increased smoking activity and younger age of onset of smoking among exposed workers were identified. Appropriate statistical adjustments were made in the analysis of respiratory conditions because of this trend.

TABLE 9: Total Family Income

Could you tell me ... (your)... total family income before taxes for 1982? *

	Percentage of			
	Exposed	(n)	Controls	(n)
1. under $9,999	4.1	(6)	6.7	(11)
2. $10,000 - $19,999	22.4	(33)	29.8	(49)
3. $20,000 - $29,999	38.8	(57)	42.1	(69)
4. $30,000 - $39,999	19.7	(29)	12.8	(21)
5. $40,000 or more	10.9	(16)	4.9	(8)
6. refused/don't know	4.1	(6)	3.6	(6)

* $x_4^2 = 8.74$, $p = .068$, excluding "refused/don't know".

$x_{lin}^2 = 8.16$, $p = .004$.

TABLE 10: Drinking Habits

In the last 12 months, about how often have you taken at least one drink of beer, wine, liquor, or any other alcoholic beverage?*

		Percentage of			
		Exposed	(n)	Controls	(n)
1.	Once a day or more	30.6	(45)	30.5	(50)
2.	2 or more times a week	15.0	(22)	25.6	(42)
3.	2 or more times a month	19.7	(29)	13.4	(22)
4.	about once a month or less	19.0	(28)	15.2	(25)
5.	not at all in the last 12 months	14.3	(21)	15.2	(25)
6.	refused/don't know	1.4	(2)	0.0	(-)

* $x_4^2 = 6.85$, $p = .144$, excluding "refused/don't know".

$x_{lin}^2 = .523$, $p = .47$

TABLE 11: Experience with Cigarettes

Variable		Percentage Responding "Yes"				
		Exposed	(n)	Controls	(n)	$p(x^2)$
1a.	... ever smoked cigarettes daily?	76.9	(113)	70.7	(116)	*
b.	... never smoked	17.0	(25)	21.3	(35)	
c.	... used to smoke occasionally	5.4	(8)	7.3	(12)	
d.	... now smoke occasionally	.7	(1)	.6	(1)	
2.	... currently smoke cigarettes daily	44.2	(65)	40.9	(67)	.55
3.	... number of cigarettes now smoked a. 0	55.8	(82)	59.1	(97)	.38**
	b. less than 10	3.4	(5)	4.9	(8)	
	c. 10-19	6.8	(10)	6.7	(11)	
	d. 20-25	26.5	(39)	22.7	(37)	
	e. more than 25	7.5	(11)	6.1	(10)	
4.	... age started smoking daily □ 10 or younger	8.7	(10)	6.6	(8)	.129 △
	11-15	35.7	(40)	24.0	(28)	
	16-20	44.3	(50)	57.0	(66)	
	older than 20	11.3	(13)	12.4	(14)	

* $x^2_2 = 1.51$, $p = .47$ for analysis combining categories "c" and "d".

$x^2_{lin} = 1.34$, $p = .247$

** $x^2_{lin} = .77$, based on 4 point analysis combining categories "b" and "c".

△ $x^2_{lin} = 2.30$, based on 4 point analysis

□ proportion of those who ever smoked daily

Exposure to Toxic Substances (Table 12) - The respondents were asked to report exposures to toxic substances in jobs other that those at the landfill site since the beginning of their working lives. This meant that the controls were able to report a complete list of exposures, while the exposed workers could only report exposures before (or after) landfill site employment. This is reflected in large differences in reported exposure to petroleum products, solvents, fertilizers and pesticides, and paints and plastics. In theory, these differences could exert a conservative or non-conservative bias on the outcome of this health study. The most likely scenario would occur where individuals exposed to a toxic substance are at higher risk of a health outcome of interest and a higher proportion of exposed persons is found in the control group. An unadjusted analysis would underestimate the effect of landfill site exposure, while adjustment for exposure to the toxic substance would enhance the landfill site effect. Happily, the effect of adjustment for exposure to toxics was minimal in the main analyses.

(c) Main Analysis

Table 13 gives results for 13 individual health conditions and groups of related complaints from the main list of 120 complaints in the questionnaire. The combined respiratory group includes the 3 respiratory conditions listed separately in the table, and the combined skin group includes skin rash, which is also listed separately. Together, the items in Table 13 include all individual

TABLE 12: Exposure to Various Toxic Substances at Places Other than the Upper Ottawa Street Landfill Site

	Question	Percentage Responding "Yes" Exposed	(n)	Control	(n)	x^2	$p(x^2)$
	In the past 30 years, that is anytime since 1953, did you work at any job where you came into contact with -- or where you were exposed to -- any of the substances listed? ... For this question, do not include anything relating only to the Upper Ottawa Street Landfill Site.						
1.	Dusts (any of 11 groups listed)	58.5	(86)	48.3	(79)	3.27	.071
2.	Petroleum products (any of 5 groups listed)	42.9	(63)	57.3	(94)	5.92	.015
3.	Solvents (any of 4 groups listed)	25.9	(38)	51.2	(84)	19.88	$<.0001$
4.	Fertilizers and Pesticides (any of 3 groups listed)	21.8	(32)	48.8	(80)	23.39	$<.0001$
5.	Paints and Plastics (any of 7 groups listed)	32.0	(47)	51.8	(85)	11.71	.0006
6.	Other fumes and gases	30.6	(45)	39.0	(64)	2.05	.151
7.	Radiation (ionizing or non-ionizing)	2.7	(4)	4.3	(7)	.185	.667
8.	Metal Fumes	42.9	(63)	47.6	(78)	.692	.405

TABLE 13: Risk of Adverse Health Outcomes Associated with Landfill Site Exposure

Health Condition (confounding variables included in the model)*	Analysis 1				Analysis 2				Analysis 3			
	Relative Risk	p(RR)	n of events cases	controls	Relative Risk	p(RR)	n of events cases	controls	Relative Risk	p(RR)	n of events cases	contro
1. chronic bronchitis (a,b,c,d)	3.52	.015	12	4	4.18	.015	10	3	6.49	.008	10	2
2. difficulty breathing (a,b,c,d)	1.45	.143	19	15	2.12	.038	16	9	1.58	.167	11	8
3. daily cough (a,b,c,d)	2.38	.006	22	14	3.29	.005	16	7	2.83	.030	10	5
4. combined bronchitis, emphysema, difficulty breathing, daily cough (a,b,c,d)	1.81	.008	40	30	2.57	.0009	32	17	2.31	.006	25	15
5. skin rash (d,e,g,h)	1.40	.204	14	12	1.73	.125	12	8	1.60	.166	11	8
6. combined skin rash, unusual acne, discolored patches on skin (d,e,g,h)	1.83	.024	27	21	1.83	.057	17	13	1.83	.057	17	13
Cardiac 7. angina, heart attack (a,b)	2.19	.016	20	12	1.76	.077	15	10	1.70	.115	12	9
8. arthritis/rheumatism (a,b,c)	1.59	.043	32	26	1.93	.019	25	17	1.83	.057	22	16
9. red, itchy eyes (d,e,g)	1.63	.130	13	10	4.14	.021	8	3	N/A	N/A	N/A	N/A
Mood Symptoms 10. anxiety, depression, trouble sleeping, irritability, restlessness (a,e,f,g,i)	4.70	<.0001	29	11	3.58	.003	17	8	4.72	.0001	15	6

(continued on next page)

TABLE 13: Risk of Adverse Health Outcomes Associated with Landfill Site Exposure

Health Condition (confounding variables included in the model)*	Analysis 1				Analysis 2				Analysis 3			
	Relative Risk	p(RR)	n of events		Relative Risk	p(RR)	n of events		Relative Risk	p(RR)	n of events	
			cases	controls			cases	controls			cases	contro
Narcotic Symptoms												
11. headaches, dizziness, lethargy, balance problems (a,e,f,g,i)	2.45	.005	25	14	2.49	.014	19	10	4.72	.005	17	5
12. tremors, cramps, spasms (a,e,f,g,i)	2.23	.078	13	6	N/A**	N/A**	N/A**	N/A**	N/A**	N/A**	N/A**	N/A**
13. muscle weakness (arms & legs) (a,e,f,g,i)	2.58	.015	16	9	2.89	.022	11	6	1.64	.240	5	4

Total eligible for each analysis :

1.	284	6.	311	10.	311
2.	302	7.	308	11.	311
3.	290	8.	288	12.	305
4.	311	9.	302	13.	309
5.	300				

Overall

n of cases = 147
n of controls = 164
Total 311

p - values are based on Z distribution, 1-tailed
too few events were specifically confirmed by a physician to warrant further analysis
**too few events were seen by a physician to warrant further analysis
* a = age (stratified by age at onset of entry into study group: 0-29, 30-49, 50+)
b = smoking status
c = non-landfill site exposure to dusts
d = non-landfill site exposure to fumes and gases
e = non-landfill site exposure to solvents
f = non-landfill site exposure to pesticides
g = non-landfill site exposure to plastics
h = non-landfill site exposure to petroleum products
i = alcohol intake

health conditions or biologically related clusters of conditions where there was a 50 per cent or greater difference in the incidence (not adjusted for age or follow-up time) between exposed workers and controls and at least 15 eligible events in total. In all cases, the cumulative incidence among the exposed workers turned out to be greater than the controls. In general, the conditions eligible for analysis fell within the anticipated range of potentially environmentally-related complaints. This was true for the respiratory, dermal, irritant, mood, narcotic, and neuromuscular symptoms, but not for arthiritis/rheumatism or cardiac conditions. The data was analyzed in the following way:

Analysis 1 - All self reported events were included except those where the individual had reported seeing a physician and no evidence of the condition could be found on the physician chart. In such cases, person-years were contributed up to, but not beyond, the date of self-reported illness.
Analysis 2 - All other events which were not "confirmed" or "possibly confirmed" on medical chart abstraction were excluded. This meant that information from those refusing chart abstraction, those who did not see a physician, or who saw a physician unknown to us, was excluded.
Analysis 3 - Only those events which were "confirmed" on medical chart abstraction were included.

The following relationships were observed:

1. There was a strong and consistent association between reports of chronic bronchitis, daily cough, and combined respiratory complaints (see Table 13) with landfill site exposure, irrespective of the exclusion of unconfirmed

self-reports. No similar between-group differences were noted for other respiratory problems such as asthma or pneumonia.

2. An association with a combined variable based on the first repondent report of skin rash, 'unusual acne', or new discoloured skin patches and landfill site exposure was identified, irrespective of the exclusion of unconfirmed self-reports. This association was much weaker than that with the respiratory group. It was influenced by our choice of confounders. In a previous analysis where marital status was included as a confounder, relative risks greater than 2.0 were seen among the exposed group.

3. Strong and consistent associations were found between mood symptoms (anxiety, depression, trouble sleeping, irritability and restlessness) and narcotic symptoms (headaches, dizziness, lethargy, balance problems), with landfill site exposure, irrespective of medical chart abstraction status.

4. The analysis of the association between irritant symptoms and neuromuscular symptoms with landfill site exposure was limited as a result of the relatively small proportion of these symptoms reported to a physician or confirmed by medical chart abstraction.

5. A consistent, though biologically unexplained, association between arthritis and landfill site exposure was identifed, irrespective of medical chart abstraction status. It should be noted that the relative risk did not exceed 2.00.

6. An association of angina and "heart attack" with landfill site exposure was seen in Analysis 1, but the association lost its statistical significance when only medical chart confirmed events were considered in Analysis 3.

No association was found between landfill site exposure and several major chronic health problems not thought to be related to toxic chemicals. These included high blood pressure (crude incidence in exposed workers equalled 20.7 percent, in controls, 15.3 percent), stroke (1.4 percent, 1.8 percent), diabetes (2.7 percent, 2.4 percent), gall bladder disease (2.1 percent, 1.8 percent), and stomach ulcer (6.8 percent, 6.3 percent). No associations were seen between landfill site exposure and any gastrointestinal, hematologic, or genitourinary conditions.

(d) Time Clustering

The first subanalysis was designed to answer the question, Did the onset of the conditions in the main analysis cluster during the time period when it was thought that the largest volumes of waste were being disposed of at the landfill? If the conditions of interest were caused by short-term exposures and did not involve a long latent period before onset of symptoms, intensity of exposure should have corresponded with concurrent risk.

The 1976-1980 period was the time when the largest volumes of industrial waste were recorded, and the solidification plant was in operation. However, the existing records did not help describe the conditions of disposal during different time periods. It is possible that human exposures to various substances were greater during the

period before the solidification plant went into operaton (1970-1975). For this reason, there is no reason to expect that there should be a monotonic relationship between volume of recorded dumping and levels of exposure.

Another problem involves the nature of incident health events. Most of the conditions of interest might involve recurrences of symptoms due to different causes. Since information was only collected about the first episode of symptoms, only these counted in the time cluster analysis. This led to the problem that first episodes might have pre-empted later episodes of equal significance, potentially biasing the analysis against identifying clusters in more recent time periods.

A descriptive analysis of the data was conducted to identify the conditions whose maximum risk of first onset was during either 1970-75 (the period of rapidly increasing volume of disposal) or 1976-80 (the period of maximum disposal). These were the periods of greatest environmental risk, while 1965-1969 (a period of presumed low volume disposal) and 1981-1983 (the period after the site was closed) were periods of low environmental risk. Cumulative incidence rates for each condition were calculated for each time period, including in the denominator the person-years of exposure within the time period of interest and excluding the person-years of exposure of those who had reported onset of symptoms in a previous time period. Tests of statistical significance were not included because of the small number of events in each time period.

Table 14 shows the conditions by period of maximum relative risk, and the magnitude of the relative risk using "analysis 1" data (Table 13). Appendix Table (g) shows the distribution of events by period of exposure for exposed and control workers, and the time-specific incidence rates used to create Table 14. The following

TABLE 14: Period of Highest Relative Risk by Condition as Indicated by Events/1000 Man Years in Exposed compared to Controls

	Period	Relative Risk*
Combined respiratory	1965-69	3.65
Combined skin	1965-69	5.05
Chronic Bronchitis	1970-75	Inf.
Difficulty breathing	1970-75	3.32
Daily cough	1970-75	3.30
Combined cardiac	1970-75	2.54
Skin rash	1970-75	Inf.
Arthritis/rheumatism	1970-75	2.28
Mood symptoms	1976-80	9.41
Narcotic symptoms	1976-80	8.53
Muscle weakness (arms & legs)	1976-80	2.99
Red, itchy eyes	1981-83	2.27
Tremors, cramps, spasms	1981-83	9.19

*A relative risk of "inf" (infinity) indicates a situation in which there were some events in the exposed group but none in the controls. Before we would accept this as indicating the period of highest relative risk, it had to meet the criterion of at least five events in the exposed group. If there were fewer than five events, the period was not considered and instead the period of highest relative risk in which there were at least some events in both groups is indicated in the table.

conclusions can be reached:

1. In general, the conditions tended to cluster in the 1970-75 and 1976-80 periods. The 1970-75 period was predominant.

2. Two conditions were clustered in the 1981-1983 period: "red, itchy eyes" and "tremors, cramps, and spasms". Concurrent exposure would likely be required if landfill exposure were to have caused red, itchy eyes, so the credibility of this association is reduced. The possibility of a latent effect of landfill exposure on the development of tremors cannot be excluded.

3. The combined respiratory and combined skin groups clustered in the 1965-69 period, despite the fact that the principal contributing conditions to both groups clustered in the 1970-75 period. This is a statistical artifact based on counting the first event within each group and does not reduce the credibility of these associations.

(e) Risk Gradient with Duration of Exposure and Time Since First Exposure

Table 15 presents the conditions by the maximum risk time period since first exposure using "analysis 1" data (Table 13). Three time periods were chosen: 0-5 years, 6-10 years, and 11-18 years since first exposure. The person-years of exposure used to calculate rates were those within each time since first exposure period. (No age adjustments were made). It is clear from the table that the onset of these conditions tended to cluster in the first 5 years since exposure. This data implies that, if landfill site exposure were

TABLE 15: Period of Highest Risk (Exposed versus Controls) In Terms of Years Since First Exposed, by Condition

Condition	Years since First Exposure	Relative Risk
Chronic bronchitis	0 - 5	3.42
Difficulty breathing	0 - 5	3.85
Combined repiratory	0 - 5	2.03
Skin rash	0 - 5	1.92
Combined Skin	0 - 5	4.85
Arthritis/rheumatism	0 - 5	2.06
Narcotic symptoms	0 - 5	3.59
Mood Symptoms	0 - 5	5.11
Muscle weakness (arms & legs)	0 - 5	6.61
Daily cough	6 - 10	3.31
Combined cardiac	6 - 10	3.89
Red, itchy eyes	6 - 10	6.73
Tremors, cramps, spasms	6 - 10	6.69

their cause, there conditions would not require long-term cumulative exposure but would result from short-term or acute exposure. The four conditions whose period of maximum relative risk occurred six to ten years after exposure, included two (tremors, cramps, spasms; and red itchy eyes) which also clustered in the 1981-1983 period, and one (combined cardiac) which is highly age dependent. Appendix Table (h) shows the distribution of events by time since first exposure for both groups, and the time-specific incidence rates used to create Table 15.

An analysis of risk by duration of exposure was excluded from this report because of 4 significant threats to validity.

1. Table 15 revealed that the period of maximum risk for most conditions was within the first 5 years since first exposure. Therefore, a requirement for long-term exposure before first onset of symptoms had not been demonstrated.

2. Inspection of the age distribution and date of exposure for those reporting 5 or more years of exposure (n=47) and those reporting less than 5 years exposure (n=100) revealed that there was insufficient overlap for simple adjustment procedures to handle between-group differences.

3. Person-years of exposure were based on self-reports of hours per week at the landfill. No employer data was available. Wide differences in estimates of exposure time among workers with common job descriptions led us to question the credibility of this data. In particular, we were unable to relate each health problem to a reliable estimate of individual cumulative exposure up to the date of onset of the condition.

4. Because most of the complaints of interest were highly symptomatic, workers experiencing them within a few years of starting work at the landfill might have applied for job changes, leaving those without symptoms to accrue longer duration of exposure.

(f) Risk Associated with On-Site Exposure versus Exposure Adjacent to the Landfill

As described in the materials and methods section, the exposed workers were divided between those who worked directly on the landfill site and those who worked at the city works yard or firefighter training station adjacent to the site. In the absence of valid individual exposure data, this distinction represented the best available index of intensity of exposure and was not confounded by differing age distributions. Table 16 shows the gradient of risk associated with on-site exposure, exposure adjacent to the landfill, and non-exposure. The data is analyzed for evidence of linear trend. Strong evidence of linear trend was demonstrated for chronic bronchitis, daily cough, mood and narcotic symptoms, as well as for muscle weakness in arms and legs, and the combined respiratory variable. Evidence of a monotonic increase in the incidence rate of the combined skin variable was also evident, but it achieved only borderline (p=0.080) statistical significance.

(g) Correlations between Health Conditions

The health conditions of interest in this study involved different organ-systems. If they were caused by a common source of exposure, there might have been evidence of a 'landfill site syndrome'. Such a syndrome would be evident if the health conditions of interest tended to occur in common in exposed individuals to a greater extent than in controls. Table 17 shows the results of

TABLE 16: Risk Associated with Gradient of Exposure - On-site, Adjacent to the Landfill, and Controls.

		Exposure Group	Incidence % (n)		x^2lin	$p(x^2)$
1.	Chronic bronchitis	On-site	13.3	(8)	8.44	.004
		Adjacent	5.3	(4)		
		Controls	2.7	(4)		
2.	Difficulty breathing	On-site	17.5	(11)	2.50	.114
		Adjacent	10.1	(8)		
		Controls	9.3	(15)		
3.	Daily cough	On-site	23.0	(14)	6.75	.009
		Adjacent	10.8	(8)		
		Controls	9.0	(14)		
4.	Combined Respiratory	On-site	34.3	(23)	6.28	.012
		Adjacent	21.3	(17)		
		Controls	18.3	(30)		
5.	Cardiac	On-site	11.9	(8)	1.85	.173
		Adjacent	15.2	(12)		
		Controls	7.4	(12)		
6.	Skin Rash	On-site	12.1	(8)	.98	.323
		Adjacent	7.8	(6)		
		Controls	7.6	(12)		
7.	Combined skin rash, unusual acne, discolored patches on skin.	On-site	22.4	(15)	3.07	.080
		Adjacent	15.0	(12)		
		Controls	12.8	(21)		
8.	Red, itchy eyes	On-site	12.5	(8)	2.07	.150
		Adjacent	6.4	(5)		
		Controls	6.3	(10)		
9.	Arthritis/rheumatism	On-site	15.9	(10)	.13	.715
		Adjacent	29.7	(22)		
		Controls	17.0	(26)		
10.	Mood Symptoms	On-site	22.4	(15)	7.87	.005
		Adjacent	12.5	(10)		
		Controls	8.5	(14)		
11.	Narcotic Symptoms	On-site	26.9	(18)	16.86	<.0001
		Adjacent	13.8	(11)		
		Controls	6.7	(11)		
12.	Tremors, cramps, spasms	On-site	9.1	(6)	3.04	.081
		Adjacent	9.0	(7)		
		Controls	3.7	(6)		

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Table 16 con't

13.	Muscle Weakness (arms & legs)	On-site	16.4	(11)	6.47	.011
		Adjacent	6.3	(5)		
		Controls	5.5	(9)		

TABLE 17: Combined Condition Effects

$$\frac{\text{(Observed/Expected) EXPOSED}}{\text{(observed/Expected) CONTROLS}}$$

(a) Ratio > 1.5 none

(b) Ratios of .67 - 1.49

Combined Respiratory	-	Combined skin	.82
Combined Respiratory	-	Red, itchy eyes	.86
Combined Respiratory	-	Arthritis/rheumatism	.68
Combined Respiratory	-	Narcotic symptoms	.75
Combined Respiratory	-	Mood Symptoms	.89
Cardiac	-	Combined skin	.89
Cardiac	-	Arthritis/rheumatism	1.05
Cardiac	-	Tremors, cramps, spasms	.74
Combined Skin	-	Arthritis/rheumatism	1.13
Combined Skin	-	Mood symptoms	.68
Combined Skin	-	Muscle weakness (arms & legs)	.67
Red, itchy eyes	-	Arthritis/rheumatism	1.12
Red, itchy eyes	-	Muscle weakness(arms & legs)	1.17
Arthritis/rheumatism	-	Mood symptoms	.74
Tremors, cramps, spasms	-	Mood symptoms	1.09
Mood symptoms	-	Muscle weakness (arms & legs)	.67

(c) Ratios of less than .67

Combined respiratory	-	cardiac	.46
Combined respiratory	-	Tremors, cramps, spasms	.21
Combined respiratory	-	Muscle weakness (arms & legs)	.38
Cardiac	-	Narcotic symptoms	.45
Cardiac	-	Mood symptoms	.47
Cardiac	-	Muscle weakness (arms & legs)	.30
Combined Skin	-	Red, itchy eyes	.61
Combined Skin	-	Narcotic symptoms	.47
Combined Skin	-	Tremors, cramps, spasms	.28

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Arthritis/rheumatism	Narcotic symptoms	.31
Arthritis/rheumatism	Tremors, cramps, spasms	.45
Arthritis/rheumatism	Muscle weakness (arms & legs)	.51
Narcotic symptoms	Tremors, cramps, spasms	.15
Narcotic symptoms	Mood symptoms	.57
Narcotic symptoms	Muscle weakness (arms & legs)	.35
Red, itchy eyes	Narcotic symptoms	.51
Red, itchy eyes	Mood symptoms	.65

(d) Ratios impossible to compute (0 overlaps observed among controls)

Cardiac - Red, itchy eyes (2 overlaps observed - 1.77 expected in exposed)

Red, itchy eyes - Tremors, cramps, spasms (3 overlaps observed - 2.61 expected in exposed)

Tremors, cramps, spasms - Muscle weakness (arms & legs) (5 overlaps observed - 1.41 expected in exposed)

analysis for these combined effects. The approach was as follows:

> The number of respondents expected to develop each pair of health conditions was calculated on the assumption that the conditions occurred independently of one another. For example, the expected number of respondents with conditions A and B = incidence rate (A) x incidence rate (B) x total number of respondents. This was calculated separately for exposed workers and controls. Triple or greater combinations were not calculated because the expected and observed numbers were too small. The ratio of observed to expected pairs was then calculated and compared between exposed workers and controls, using the following fraction:
>
> $$\frac{(\text{Observed/Expected})\ \text{Exposed}}{(\text{Observed/Expected})\ \text{Controls}}$$
>
> This method controlled for the fact that health problems did not occur independently in the unexposed population. Ratios greater than 1.0 would suggest combined effects among the exposed workers, ratios less than 1.0 would suggest combined effects among the controls or an absence of a landfill site syndrome. Table 17 shows that the overall tendency was for greater between-symptom correlations to occur in the controls, rather than in the exposed workers. Seventeen ratios were less than 0.67 and only five were greater than 1.0. None was greater than 1.5. Therefore, there was no evidence of a landfill site "syndrome". It is unclear whether this is due to a highly random distribution of the excess health problems among the landfill workers or to combined effects among the controls.

Simulations demonstrated that this approach to estimating the ratio of observed to expected combined effects was conservative. The expectation of combined effects increased with increasing incidence for each condition involved in a combined effect. Since exposed workers generally had higher incidence rates of the conditions of interest, the expectation of combined effects was greater for them than the controls. An alternate approach would have been to use the expected number of combined effects in the controls as the expected number for the exposed workers too. Incidence rate A controls x Incidence rate B controls x total controls . This would have reduced to the ratio $\frac{\text{Prob AB (exposed)}}{\text{Prob AB (controls)}}$, since the expected number of combined effects would have cancelled across numerator and denominator. Simulations showed that this approach had the opposite tendency to the other approach. Combined effects would have been overestimated with an increased number of events in the exposed group.

(h) Health Status Differences at Time of Interview

At the time of interview, study respondents were asked whether or not they still had each of the health conditions they reported. Using this information, the health conditions of interest were re-analyzed for between-group differences in current prevalence. Those events which were included in Analysis 1 in the main analysis (Table 13) were followed forward in time and included if the respondents said they still had the condition at time of interview. This was done to answer the question: have the health status differences which emerged after first exposure to the landfill persisted to the present? Table 18 shows that for all conditions

TABLE 18: Relative Prevalence of Selected Health Conditions at Time of Interview

	Condition	n of events (exposed, controls)	Odds Ratio* (exposed, controls)	(p)	Table 13 - Analysis 1 (n)	Relative Risk	(p)
1.	Chronic bronchitis	(6,2)	3.80	.091	(12,4)	3.52	(.015)
2.	difficulty breathing	(18,12)	1.50	.321	(19,15)	1.45	(.143)
3.	daily cough	(18,7)	3.22	.020	(22,14)	2.38	(.006)
4.	combined respiratory	(32,30)	2.80	.047	(40,30)	1.81	(.008)
5.	skin rash	(12,6)	1.83	.233	(14,12)	1.40	(.204)
6.	combined skin	(20,9)	2.30	.076	(27,21)	1.83	(.024)
7.	cardiac	(14,7)	2.96	.005	(20,12)	2.19	(.016)
8.	arthritis/rheumatism	(30,19)	1.95	.049	(32,26)	1.59	(.043)
9.	red, itchy eyes	(10,6)	1.49	.354	(13,10)	1.63	(.130)
10.	mood symptoms	(27,6)	5.09	.0015	(29,11)	4.70	(<.0001
11.	narcotic symptoms	(23,9)	2.72	.026	(25,14)	2.45	(.005)
12.	tremors, cramps, spasms	(13,6)	2.49	.083	(13.6)	2.23	(.078)
13.	muscle weakness (arms & legs)	(16,5)	3.61	.016	(16,9)	2.58	(.015)

* Age-adjusted by logistic regression.

except red, itchy eyes, the odds ratio is greater than its respective relative risk from Table 13. At the same time, all p-values have increased. For all conditions except "chronic bronchitis" and "tremors, cramps and spasms", the proportional decrease of controls reporting still having the condition was greater than the exposed workers. (For chronic bronchitis and tremors, cramps, and spasms, the proportional decrease is equal between exposed workers and controls). Inspection of the table reveals that the differences in odds ratios and p-values from Table 13 to Table 18 are related both to differing statistical methods and the differences between incidence and prevalence of the conditions of interest. In general, the proportional decrease between analyses are not strikingly greater among acute than chronic conditions. Chronic bronchitis and cardiac symptoms show greater proportional decreases than red, itchy eyes or skin rash. However, proportional decreases in "difficulty breathing" and "arthritis/rheumatism" are predictably low. These results reflect a variety of influences: time from condition onset to the present (see Table 14), subject interpretation of what "still having a condition" means, the validity of the original report, and the nature and severity of the underlying pathology involved, and the presence or absence of ongoing exposure to causative factors. The effects of these factors cannot be estimated separately using the data in this study. However, the data does show that health status differences which emerged after first exposed to the landfill have persisted.

(i) Other Health Problems

Table 19 gives information about work-related injuries and reproductive history. The experience of the exposed workers and controls with respect to work-related injuries was similar, with approximately 75 percent of both groups reporting at least one work-related injury. A similarly high proportion of each group (68 percent of exposed workers and 59.8 percent of controls) received Worker's Compensation payments at least once. Review of available

TABLE 19: Exposed and Controls by Selected Health-Related Variables

	Question	Exposed n (%)		Controls n (%)		$p\ (x^2)$
1.	Have you ever had a work-related injury?	111	(75.6)	122	(74.4)	.82
2.	Have you ever actually received Workman's Compensation payments?	100	(68.0)	98	(59.8)	.13
3.	...Has your (wife/partner) ever been physically unable to become pregnant after one year of trying?*	13	(10.0)	9	(6.7)	.33
4.	Proportion of spontaneous abortions among pregnancies occurring after first exposure.**	18	(19.1)	8	(10.5)	.12

* excluding those subjects without a wife/partner or who have never tried to start a pregnancy (total exposed = 130, total controls = 135)

** total offspring: 94 among the exposed, 76 among the controls. (No stillbirths and 3 birth defects occurred among offspring of the exposed workers, no stillbirths and 4 birth defects occurred among the offspring of the controls.)

records suggested that these were almost exclusively due to musculo skeletal injury. There was no evidence of claims for chemical-related diseases from exposure at the landfill.

No statistically significant between group differences were found in the one-year infertility rate or spontaneous abortion rate. Problems with spouse recall, identification of spontaneous abortions, and denial of infertility make interpretation of the non-statistically significant trends difficult. No stillbirths occurred among the pregnancies beginning after first exposure at the landfill. Three birth defects were reported among 94 offspring of exposed workers who were born after the workers' first exposure. (One hearing problem, one kidney/bladder problem, and one large birth mark). Four birth defects were reported among 76 offspring of controls born after first exposure to the job which qualified them for the study. (One muscular dystrophy, one hemangioma, one hip displacement, and one toe deformity).

(j) Mortality

A total of 21 exposed workers were reported to have died between 1965 and the end of 1983. Twenty of these were found in the Ontario Death Registry. Their identities were verified by occupation and address at death. One deceased worker was lost to follow-up. The remaining 20 deaths were analyzed using proportional mortality (PMR) and standardized mortality (SMR) approaches. The PMR approach [Table 20(a)] involved dividing the probability of each death (which is 1.00 overall) into sub-probabilities for each relevant disease. The probability assigned to each disease (a number between 0.00 and 1.00) was proportional to the death rate for that disease among all Ontario males of the same age and sex as the decedent, for the calendar year in which he died. The sum of these disease-specific probabilities must add to 1.00. Thus, the overall distribution of expected causes

of death is the sum of the disease-specific probabilities of death for each decedent, added across all 20 decedents. Because the overall observed and expected numbers of deaths are equalized in the PMR approach, it can be biased by undetected differences in the overall mortality rate between the exposed population and the reference group (all Ontario males). An apparent increase in the proportional mortality of cancer, for instance, might be an artifact due to real decrease in cardiovascular mortality, or vice versa. To check whether this bias occurred, an SMR (standardized mortality ratio) analysis was included to supplement the PMR analysis. The SMR analysis includes information from both live and deceased workers. Each person-year between a worker's first year of exposure to the landfill site and the year of death (for the decedents) or of interview (for the live workers) involves a finite probability of death from each relevant disease, based on age, sex, and calendar-year specific Ontario death rates. These disease-specific probabilities are added across all eligible person-years to give the expected number of deaths from each relevant cause. The overall expected number of deaths will differ from the observed because it reflects the true mortality rate of the comparison population. When cohort ascertainment is complete, the SMR analysis would be preferred, and the PMR would not be reported. In this case, cohort ascertainment is likely incomplete, therefore the person-years at risk and the mortality experience might be subject to unknown biases. We assumed that all deceased workers began work before 1965, and therefore contributed maximum person-years at risk before death. This assumption would partially offset the loss of person-years due to loss of follow-up among those who refused interview. Table 20(b) shows the SMR analysis, which demonstrates that the proportional mortality rates were not influenced very much by overall differences in mortality rates. This overall pattern of mortality is consistent with many occupational cohorts. A "healthy worker effect" is reflected in the "all causes" SMR of 88, based on reduction of cardiovascular and "other causes" mortality. These

TABLE 20 (a): Proportional Mortality Among Exposed Workers

	Cause of Death	ICD Code	Expected*	Observed	PMR	CI95**
1.	All Cancer (including Leukemia)	140-239.9	5.03	6	119	47 - 216
	(a) Respiratory Cancer	160-165.9	1.83	3	164	35 - 414
2.	Cardiovascular	390-459.9	10.24	9	88	45 - 134
3.	Respiratory System (excluding Cancer)	460-519.9	1.32	2	152	19 - 480
4.	All Other Causes	------	3.41	3	88	19 - 222
	TOTALS		20.00	20		

TABLE 20 (b): Standardized Mortality Ratios Among Exposed Workers

	Cause of Death	Expected*	Observed	SMR	CI95**
1.	All Cancer (including Leukemia)	5.31	6	113	41 - 247
	(a) Respiratory Cancer	1.83	3	164	33 - 481
2.	Cadiovascular	11.72	9	77	34 - 146
3.	Respiratory System (excluding Cancer)	1.47	2	136	14 - 146
4.	Other Causes	4.30	3	70	14 - 205
	TOTALS	22.80	20	88	

* Expected cause of death based on age-specific, cause-specific mortality rates for all Ontario males by 5-year intervals, 1965 to the present

International Classification of Diseases, 9th Revision

** 95% confidence intervals around PMR/SMR estimates

observations lend credibility to the trend to increased respiratory mortality from cancer and non-cancer causes. Because of the low power of these analyses, it cannot be concluded that landfill site exposure has not conferred a mortality risk on those exposed. However, no statistically significant risk was evident by 1983.

(k) Comparisons using Canada Health Survey Questions

The long-term health problem items from the Canada Health Survey (CHS) [20] were embedded in a separate part of the questionnaire to answer the question: Would use of CHS data instead of a locally-selected control group have given similar results? That is, could this survey have been carried out using only aggregate morbidity data for comparison purposes? The CHS items differed from the main health questions in three important ways.

1. They related to current prevalence of certain long-term health problems, not to cumulative incidence over time.

2. Some of the items were much broader than the main workers' study questionnaire items (for instance, "Mental Disorders" on the CHS covered several items from the main questionnaire).

3. The CHS used one respondent per household for the long-term problem items, so that much of the data was reported by proxy. The worker's study used entirely first person interviews.

To overcome these difficulties, comparisons were made separately between the exposed workers, the controls, and all male CHS blue collar workers (the CHS sample), in three comparisons. Table 21 shows the separate age-adjusted comparisons between the CHS sample and the

TABLE 21: Relative Prevalence of Canada Health Survey Long-Term Health Problems at Time of Interview: Exposed and Controls Versus Canada Health Survey Blue Collar Workers

Condition	Exposed vs CHS		Controls vs CHS	
	Odds Ratio*	(p)	Odds Ratio*	(p)
1. Skin allergies	5.85	<.0005	3.47	<.01
2. Hayfever	2.15	---	2.28	---
3. Asthma	1.30	---	3.74	.025
4. Arthritis	2.88	<.0005	1.76	<.025
5. Bronchitis & Emphysema	3.94	<.005	2.49	.05
6. Mental Disorders	2.36	---	.23	.005
7. High Blood Pressure	2.34	<.025	2.20	.025
8. Heart Disease	1.93	---	1.44	---
9. Kidney Disorders	5.91	<.05	4.32	---
10. Stomach Ulcer	3.93	<.01	1.52	---
11. Digestive Disorders	4.05	<.01	2.45	---
12. Migraine Headaches	6.51	<.0005	2.34	---
13. Sight Disorders	2.41	<.05	.91	---
14. Hearing Disorders	2.89	<.005	1.79	---
15. Dental Problems	2.32	<.025	1.14	---
16. Other Respiratory	12.45	<.0005	4.32	---
17. Injury	6.51	<.005	2.72	---
18. Limb/Joint Disorders	3.34	<.0005	2.01	.025

* Age-adjusted by logistic regression.

exposed and control workers. The exposed workers differed from the CHS sample in all items (odds ratios 1.30 - 12.45), with high levels of statistical significance in 14 of 18 items. Most of these did not show up as differences in the main questionnaire. The trend for the controls was similar, although less marked. The odds ratio was greater than one (1.14 - 4.32) in 16 of 18 items, and less than one (.91, .23) in 2 items. Seven items achieved high levels of statisticial significance. Six of these related to an increased prevalence among the controls. One (mental disorders) related to an increased prevalence among the CHS sample. Table 22 shows the comparison between exposed workers and controls for the CHS items. The results of this analysis were broadly similar to the analysis of the "prevalence at the time of interview" of the main questionnaire items. The only major inconsistency was evidence of an increased prevalence of asthma among the controls, not found in the main analysis. This was explained by the fact that the prevalence of asthma was greater in the controls before members of either group began work at their qualifying occupation.

Taken together, the data in Tables 21 and 22 emphasize the need for a locally selected control group and demonstrate the huge bias that would have been introduced if CHS data had been used as a benchmark comparison. Although the differences found may have related to health status, it is more likely that the setting of the study, different interview methods, and geographic problems with study subject comparability were crucial factors.

(1) Quality of Self-Reported Health Histories

The main analysis included information from the medical chart abstraction study to give results for "confirmed" health events, in an effort to eliminate recall bias. In general, recall bias did not

TABLE 22: Relative Prevalence of Canada Health Survey Long-Term Health Problems at Time of Interview: Exposed versus Controls

Condition	Exposed %	Controls %	Odds Ratio*	(p)
1. Skin Allergies	16.3	11.0	1.67	.134
2. Hayfever	5.4	11.0	.64	.355
3. Asthma	2.0	7.3	.28	.044
4. Arthritis	28.6	18.3	1.71	.069
5. Bronchitis & emphysema	11.6	7.3	1.73	.171
6. Mental Disorders	6.8	0.6	11.76	.037
7. High Blood Pressure	13.6	12.8	1.03	.937
8. Heart Disease	8.8	7.3	1.20	.604
9. Kidney Disorders	4.8	3.0	1.42	.55
0. Stomach Ulcer	8.8	4.3	2.18	.116
1. Digestive Disorders	8.2	5.5	1.36	.526
2. Migraine Headaches	12.2	4.3	2.75	.014
3. Sight Disorders	8.2	4.3	2.07	.161
4. Hearing Disorders	16.3	11.6	1.45	.273
5. Dental Disorders	10.9	4.9	2.11	.106
6. Other Respiratory	11.6	4.9	2.56	.037
7. Injury	11.6	5.5	2.09	.087
8. Limbs/joint Disorders	30.6	18.3	1.91	.019

* Age adjustment by logistic regression

influence that analysis to a significant degree. This section examines more closely the overall evidence for recall bias and the quality of the self-reported health histories.

Table 23 shows the overall rates of confirmation for all self-reported health events on the main questionnaire, separated by those reporting and not reporting having seen a physician. These include conditions occurring before first exposure at the landfill site or analogous control job. The data of first report is open-ended, including anything the respondents could remember before 1965. Almost 72 percent of conditions were confirmed when a physician visit was reported. When possible confirmations were included, 88.9 percent were "confirmed". Confirmation from medical charts was also made on 36.5 percent of self-reports when a physician visit was not reported. A further 22.6 percent of such self-reports were possibly confirmed.

Table 24(a) shows the length of medical chart follow-up by group for individuals who had at least one chart abstracted. This was based on the nurse abstractors recording the earliest chart entry date for each chart they reviewed. The numbers in Table 24(a) give the earliest report among an individual's charts, if there were more than one. The totals equal those in Table 5(b), heading "m" (at least one chart reviewed per respondent). The distribution of chart follow-up times was similar between the two groups.

Table 24(b) shows the overall rates of confirmation by date of onset of symptoms for those conditions where a physician visit was reported. It was anticipated that rates of non-confirmation would have increased with increasing recall time. Instead, non-confirmation was lowest (1.1%) for pre-1965 conditions and highest (14.7%) for 1981-83 conditions. This may be due to increased respondent recall of minor health problems in the recent past compared to the distant past.

TABLE 23: Confirmation of Reported Illness

A. In those who reported seeing a doctor

	Confirmed		Possibly Confirmed				Not Confirmed*	Total
Category	1	2	3	4	5	6	8	
Number of events	639	96	57	33	77	7	113	1022
%	62.5	9.4	5.6	3.2	7.5	.7	11.1	100%
	71.9%		17.0%				11.1%	100%

B. In those who reported not seeing a doctor

	Confirmed		Possibly Confirmed				Not Confirmed*	Total
Category	1	2	3	4	5	6	8	
Number of events	59	17	16	8	21	2	85	208
%	28.4	8.2	7.7	3.8	10.1	1.0	40.9	100%
	36.5%		22.6%				40.9%	100%

* Excluding non-confirmation due to non-concurrence of physician records (category 7) and illegibility of records (category 9)

(see Appendix 4 for description of confirmation categories)

TABLE 24 (a): Date of Earliest Chart Report for Individuals Whose Charts Were Abstracted

Time Period	Exposed n (%)	Controls n (%)
pre - 1965	22 (19.8)	23 (21.1)
1965 - 69	19 (17.1)	18 (16.5)
1970 - 75	32 (28.8)	36 (33.0)
1976 - 80	20 (18.0)	14 (12.8)
1981 - 83	8 (7.2)	12 (11.0)
not recorded	10 (9.0)	6 (5.5)
TOTAL	111	109

TABLE 24 (b): Confirmation of Illness by Year of Report for Patients who Reported Seeing a Doctor

	Confirmation Category		
Time Period	Confirmed % (n)	Possibly Confirmed % (n)	Not Confirmed* % (n)
	1 - 2	3 - 6	8
pre 1965	76.5 (143)	22.5 (42)	1.1 (2)
1965 - 69	62.9 (61)	26.8 (26)	10.3 (10)
1970 - 75	74.9 (134)	14.0 (25)	11.2 (20)
1976 - 80	72.6 (159)	13.2 (29)	14.2 (31)
1981 - 83	70.0 (238)	15.3 (52)	14.7 (50)

$x_4^2 = 7.25$, $p = .122$ (confirmed versus other)

x^2lin $= .865$, $p = .352$

* Excluding non-confirmation due to non-concurrent physician records (category 7) and illegibility of records (category 9).

Differences between the four more recent time periods were small. No statistically significant time trend was evident when the proportion of confirmed conditions was compared with all others. Most of the variance in the time trend analysis by 3 groups (confirmed, possibly confirmed, and non-confirmed subgroups) was contributed by the pre-1965, non-confirmed rate. When pre-1965 was excluded, no time trend was evident in the three group analysis, either.

Table 25 shows the rates of confirmation for the time periods before (up to 1977) and after (1978-1983) the beginning of intense public concern about the landfill. Between-group differences in the distribution of confirmed, possibly confirmed, and not confirmed events were not evident in either time period. However, the proportion of not confirmed events rose 9.9 percent in the exposed group and 4.8 percent in the controls after the onset of publicity.

Table 26 compares the recall of exposed workers and controls by organ-system. The data exclude events where no physician visit was reported, but include events which occurred before first exposure to the landfill site or analogous non-landfill job. Statistically significant differences were seen for respiratory conditions, but not for any other organ-system. Table 27 examines the conditions of interest in the main analysis, subject to the same inclusions and exclusions as in Table 26. (These tables include events which occurred both before and after first exposure to the landfill site. Table 13 includes events in Analysis 1 which were not subject to medical chart abstraction. Therefore, the numbers in Table 27 do not correspond to those in Table 13.) Despite the trends suggested for the respiratory system as a whole, there was no evidence of increased over-reporting among exposed workers for the specific respiratory conditions of interest. None of the other conditions of interest showed trends to over-reporting among the exposed workers. Narcotic symptoms were relatively over-reported among the controls.

TABLE 25: Confirmation of Illness by Period Before and After Publicity About the Landfill Site Began (in those who reported seeing a Doctor)

A. Pre-publicity Period (before 1965 - 1977)

	Confirmed (1,2)	Possibly Confirmed (3,4,5,6)	Not Confirmed (8)	Totals
Exposed	214 (73.3%)	55 (18.8%)	23 (7.9%)	292
Controls	179 (73.7%)	47 (19.4%)	17 (7.0%)	243
TOTALS	393	102	40	535

$x_2^2 = 0.158$, $p = .924$

B. Post-publicity Period (1978 - 1983)

	Confirmed (1,2)	Possibly Confirmed (3,4,5,6)	Not Confirmed (8)	Totals
Exposed	175 (67.8%)	37 (14.4%)	46 (17.8%)	258
Controls	167 (72.9%)	35 (15.3%)	27 (11.8%)	229
TOTALS	342	72	73	487

$x_2^2 = 3.47$, $p = .176$

TABLE 26: Association Between Landfill Site Exposure and Status After Medical Chart Abstraction for Groups of Health Problems by Organ System

	Result of Abstraction*				
Condition	Confirmed	Possibly Confirmed	Not Confirmed	x^2	p
Respiratory					
Exposed	59	15	5		
Controls	44	3	1	5.62	.018
Cardiovascular					
Exposed	58	8	11		
Controls	48	9	4	.22	.642
Blood/Lymph					
Exposed	6	1	2		
Controls	13	2	2	.287	.592
Gastrointestinal					
Exposed	42	8	5		
Controls	35	11	1	.049	.824
Genitourinary					
Exposed	11	5	-		
Controls	13	1	-	2.17	.10
Skin					
Exposed	27	5	12		
Controls	23	3	4	1.91	.167
Head/Neck					
Exposed	38	11	8		
Controls	38	7	8	.326	.680
Narcotic Symptoms					
Exposed	29	4	5		
Controls	11	5	1	.282	.514
Neuromuscular Symptoms					
Exposed	48	22	8		
Controls	50	12	9	1.30	.254
Mood Disorders					
Exposed	21	3	1		
Controls	6	1	2	1.22	.270
Other Neurological					
Exposed	7	0	5		
Controls	10	3	3	.050	.823

(continued on next page)

Table 26 con't

Other						
	Exposed	47	10	6		
	Controls	46	11	3	.071	.790

* Where respondent reported seeing a physician only.

** x^2 on 1 degree of freedom (Confirmed versus other).

TABLE 27: Association Between Landfill Site Exposure and Status After Medical Chart Abstraction For Selected Health Conditions

Condition	Confirmed	Possibly Confirmed	Not Confirmed	x^2	p
Chronic Bronchitis					
Exposed	16	1	-		
Controls	10	2	-		*.348
Difficulty Breathing					
Exposed	12	4	-		
Controls	8	2	-		*.768
Daily Cough					
Exposed	13	3	-		
Controls	7	1	-		*.593
Combined Respiratory					
Exposed	45	8	-		
Controls	26	6	-	.194	.659
Skin Rash					
Exposed	10	1	2		
Controls	7	0	0		*.282
Combined Skin rash, unusual acne, discoloured patches on skin					
Exposed	17	3	6		
Controls	14	0	2		*.158
Angina/Heart Attack					
Exposed	17	4	-		
Controls	15	3	-	.037	.847
Arthritis/rheumatism					
Exposed	22	4	2		
Controls	18	1	0		*.215
Red, itchy eyes					
Exposed	3	3	3		
Controls	4	1	1		*.315
Mood Symptoms					
Exposed	15	3	1		
Controls	5	1	2		*.633
Narcotic Symptoms					
Exposed	26	2	3		
Controls	8	6	1		*.036

(continued on next page)

Table 27 con't

Tremors, cramps, spasms					
Exposed	3	2	2		
Controls	3	0	1		*.545
Muscle weakness (arms & legs)					
Exposed	4	8	-		
Controls	4	4	-	.556	.456

*Exact probability by Fischer's exact test, for 2x2 table of "Confirmed" versus "other".

Table 28 compares the percentage of exposed workers and controls who reported seeing a physician, if they had a condition in a specific organ-system. If the exposed workers were more concerned than controls about their health, as a result of landfill site exposures, it would be anticipated that they would see physicians for their health problems more readily than controls. Table 28 is confined to health problems which began after first exposure to the landfill. There is no evidence of an increased rate of self-reported physician attendance by organ-system for the exposed workers compared to the controls. In general, the trend is toward increased physician attendance among controls. It is interesting to note that only one nurse abstractor noted a case where the physician reported that the workers' visit was due to concern about landfill site exposure.

Overall, the data in Tables 23 to 28 suggest that over-reporting rates were low and unbiased between groups, and that knowledge of landfill site exposure did not alter physician utilization patterns. Under-reporting could not be assessed from these data. However, confirmation from medical charts was made for 36.5 percent of self-reports when a physician visit was not reported. This suggests that under-reporting might have been a significant problem or that our "possibly confirmed" categories were too all-inclusive. Unreported condition data, collected by organ-system at the time of chart abstraction, did not demonstrate differences between groups.

This data has not been presented in this report because it did not relate directly to the questionnaire items, and could not be used to calculate rates of under-reporting comparable to those for over-reporting.

TABLE 28: Percentage of Respondents Reporting Seeing a Doctor, if They had a Condition, by Disease Type and Group*

Disease Type	Exposed	Controls
Respiratory	82.4	87.3
Cardiovascular	94.2	91.5
Blood/Lymph	75.0	86.4
Gastrointestinal	91.7	93.1
Genitourinary	78.6	88.2
Skin	76.1	85.1
Head/Neck	75.9	83.1
Narcotic Symptoms	77.4	78.3
Neuromuscular Symptoms	77.8	90.2
Mood Disorders	54.2	56.3
Other Neurological	69.0	79.2
Other	80.5	88.0

* Includes only events after first exposure to the landfill site or analogous non-landfill job.

VI. DISCUSSION

The credibility of the association between landfill site exposure and the 13 health conditions of interest was evaluated in Table 29 by five criteria related to the data presented in the Results section,and evidence of biologic plausibility. This latter was based on evidence of inherent toxicity of compounds identified at the landfill[21](see Appendix (f)). The associations with the highest overall credibility, and therefore the greatest chance of being causative, were with chronic bronchitis, daily cough, combined respiratory problems, narcotic symptoms, and mood disorders. An intermediate level of credibility was evident with difficulty breathing, skin rash, combined skin problems, and muscle weakness. Associations with cardiac disorders; arthritis; red, itchy eyes; and tremors, cramps, and spasms were of low credibility.

The validity of these results might have been affected by four factors: multiple statistical comparisons, confounding factors, refusal rates, and the lack of clinical markers of disease.

The problem of multiple statistical comparisons arises because 13 analyses were carried out after post-hoc identification of the conditions to be analyzed. Should more stringent tests of statistical significance be used in this case? The issue of multiple statistical comparisons should be considered in light of the fact that this study is an hypothesis-generating exercise. Rules of statistical inference for hypothesis testing may be too stringent for hypothesis generating. Statistical significance testing was used in this study to help assess the credibility of a candidate hypothesis and not to accept or reject a pre-determined null hypothesis. Table 29 shows how this was combined with other information in the hypothesis generating process. We conclude that the multiple comparisons problem is not an obstacle to the acceptance of the results of this study.

TABLE 29: Summary of Criteria for Evaluating the Association of Specific Health Problems and Landfill Site Exposure

Condition	Biologic Plausibility	Strength of Association		No Evidence of non-conservative Recall Bias (Table 27)	Time Cluster (1970-75) or (1976-80) (Table 14)	Risk Gradient by Intensity of Exposure (Table 16)	Overall Credibility of the Association
		RR $\geq$ 2.0* for Analysis 3 (Table 13)	$p < 0.05$ for Analysis 3 (Table 13				
Chronic Bronchitis	+	+	+	+	+	++	High
Difficulty Breathing	+	-	-	+	+	+	Moderate
Daily Cough	+	+	+	+	+	++	High
Combined Respiratory	+	+	+	+	N/A	++	High
Combined Cardiac	+	-	-	+	+	-	Low
Skin Rash	+	-	-	+	+	+	Moderate
Combined Skin	+	-	-	+	N/A	+	Moderate
Red, Itchy eyes	+	?$^{\triangle}$	?	+	-	+	Low
Arthritis	-	-	-	+	+	-	Low
Narcotic Symptoms	+	+	+	+	+	++	High
Mood Disorders	+	+	+	+	+	++	High
Tremors, cramps, spasms	+	?	?	+	-	-	Low
Muscle Weakness (arms and legs)	+	-	-	+	+	++	Moderate

+ = monotonic trend

++ = $p < 0.05$

*See text for description of Analysis 3

$\triangle$? = Insufficient data for Analysis 3

The problem of confounding is represented by the list of variables adjusted for in the main analysis. They included smoking, alcohol intake, and non-landfill site exposure to a variety of industrial toxins. Post-hoc adjustment for confounders is less desireable than controlling for them initially through matching, stratification, or exclusion criteria. These methods were not feasible in this study setting. Nonetheless, the specific post-hoc adjustments made were not a major cause for concern. Alcohol intake and smoking patterns were very similar between groups. Differences between controls and exposed workers were most marked for exposures to industrial toxins. In general, adjustment for these exposures did not change the magnitude of the relative risk. In the case of skin disorders, adjustment for exposure to fumes and gases did slightly increase the relative risk.

Would a control group from another landfill site have been more appropriate than a group of non-landfill outdoor workers? It is possible that the selection factors which determined landfill site employment might not have been found among other outdoor workers. If these factors were health-related, then important confounders were missed in this study. Such a possibility cannot be discounted. But obtaining landfill controls from other sites would have introduced other problems. There is no way to guarantee that industrial waste would not have been disposed of in other landfill sites, leaving open the possibility of comparing exposed workers with exposed workers. Landfill workers from sites outside the area would not experience the same ambient air pollution at work as the exposed workers. This is an important concern in the Hamilton-Wentworth area where air pollution has been a public health concern. The feasibility of blinding medical chart abstractors to the exposure status of the study subjects would have been drastically reduced.

The problem of the 13 percent difference in response rate between exposed workers and controls leaves open the possibilty that some or all of the results may have been explained by volunteer bias alone. However, such a difference is not unexpected and in this case, interview refusals from both exposed and control subjects were primarily for non-health related reasons. Only a strong volunteer bias could have explained the results in Table 13. In order to eliminate a relative risk of 2.0, the incidence of the complaints of interest among the refusing controls would have to be about 50 per cent greater than the refusing exposed workers. This suggests that a volunteer bias did not significantly affect the results.

Difficulties with using clinical or pathological markers of disease in environmental health surveys have been suggested in the literature review section of this report. However, some of the most credible hypotheses which have emerged relate to narcotic symptoms and mood disorders. How can the effects of chemical exposure be separated from competing causes, such as anxiety and self-labelling phenomena, without exposure-specific tests? Despite advances in neuro-physiological and neurobehavioural testing, no battery of tests is available which could meet strict criteria for surveillance of this study population. But this does not rule out the use of clinical tests or pathologic markers to help assess the severity or reversibility of any health problems which may have persisted to the present.

VII. CONCLUSIONS

The most difficult aspect of an hypothesis-generating study like this one concerns whether or not it can be used to draw conclusions about causation. The argument against drawing conclusions is based on two lines of reasoning. First, since the study was designated as an hypothesis-generating study, it permitted methodologic compromises which could invalidate all causal conclusions. These compromises involved the use of a questionnaire that permitted over one hundred hypotheses to be entertained; analytic methods which permitted the investigators to explore the data and selectively report findings; and a non-rigorous approach to statistical inference. Second, while the unavoidable methodologic problems which arose in the conduct of this study might have been permissible in an hypothesis generating study, they might not have been acceptable in an hypothesis testing study. These included lack of independent verification of cohort completeness; lack of direct evidence of the nature and quality of worker exposure to industrial waste; differential response rates to the questionnaire; unblinded interviews; and lack of evidence of validity and reliability for the methods of medical chart abstraction.

The argument for drawing conclusions from this study begins with the view that hypothesis generating and testing are continuous, not discrete, activities on a probability scale. The epidemiologic study may be viewed as a diagnostic test, wherein the post-test probability of causation is greater than the pre-test probability if the result is positive but less than the pre-test probability if the result is negative. By accepting the label of a study as "hypothesis-generating", we are accepting the fact that it is a test; that the pre-and post-test probabilities change in the way just described. In an hypothesis testing study, the post-test probability

of causation must be higher than an hypothesis generating study because of its implications for social and health policy. There is no consensus as to what probability value needs to be achieved before causation can be assigned or what pre-test probability range corresponds to a given level of evidence for causation. In this study, the pre-test probability of causation would have been increased by our use of inherent toxicity information,[21] results of the residents' original health survey, and other biologic plausibility information in questionnaire design. The post-test probability of causation was increased by the use of multiple criteria to assess the credibility of each health outcome of interest. Those outcomes which were ranked as "high credibility" hypotheses were more likely to have been caused by landfill site exposure than those ranked "moderate" or "low", or those not entering the main analysis at all. But has the credibility of any of these hypotheses achieved a level where a scientific consensus would conclude that causation could be inferred? Here the methodologic limitations described earlier in this section dictate that such a level has not been achieved.

The hypotheses generated from this study will be tested in the main analysis of the residents' study. The Upper Ottawa Street Landfill Site Study Committee identified 19 individual adult health conditions (in five organ-system groups) from the residents' health survey corresponding to the high and moderate credibility hypotheses from the workers' study. These are the hypotheses which be tested in the residents' study. The analysis will be carried out among the adults (male and female) who belong to the two main study groups: current landfill residents who were there during the peak dumping period (1976-1980), and controls. Methods of analysis will be similar to the main analysis of the workers' study. The null hypothesis (that landfill site exposure is not associated with a condition) will be rejected if the cumulative incidence rate of the condition is greater among the exposed than the controls and the

probability of the association occurring by chance is less than 0.01. This represents p¼0.05, adjusted for multiple testing, first by the five organ-system groups (combined respiratory, skin, peripheral neuromuscular, narcotic, mood variables) and then by four to five health problems within each organ-system group (excluding peripheral neuromuscular conditions, which include only one item). Those conditions for which the null hypothesis has been rejected will be regarded as effects of exposure to the landfill.

Analysis of the residents' study will not be confined to these conditions. In addition, the Committee has identified 5 other groups of conditions which are of particular concern, based on the residents' original health survey (Appendix e) and the opportunity to study congenital and childhood effects. These include:

1. Among children: the respiratory and skin conditions from the hypothesis testing analysis.
2. Among children: the narcotic or mood conditions from the hypothesis testing analysis which can be logically separated from normal child development.
3. Among children: problems with physical, social, and emotional growth or development.
4. Among children and adults:
   - hayfever
   - asthma
   - 5 or more colds a year
   - wheezy or whistling chest for most days or nights throughout the year
   - nosebleeds (not from injury)
   - unusual nose irritation or nasal discharge
   - throat infections
   - prolonged, irritated, sore throat
   - red, itchy, watery, sore, dry or inflamed eyes

Numbness, tingling, prickling or loss of sensation on:
- legs or feet
- arms or hands

5. Among adult females: adverse reproductive outcomes.

Conclusions regarding causation from these analyses will depend upon the degree to which the residents' study has avoided major biases in design and execution.

The question of doing follow-up health studies will be addressed when the residents' study is completed. Various clinical or pathologic markers may be useful. These will be carefully scrutinized for evidence of predictive value, ability to discriminate between competing exposures (risks), clinical significance of a test result apart from its predictive value, non-invasiveness, and feasibility of administration. If proposed, these studies will be for the purpose of assessing reversibility and severity of current health problems and not to reassess causation.

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Appendix #

Respondent I.D.
(201+)

UPPER OTTAWA STREET

LANDFILL SITE

WORKERS' HEALTH STUDY

Hamilton Opinion Research Centre Ltd.
Spring 1983

HAMILTON OPINION RESEARCH CENTRE LTD.

UPPER OTTAWA STREET LANDFILL WORKERS' HEALTH STUDY

SPRING 1983

Interviewer: Read out regular type only.

Do NOT read out words in italics.

Hello, my name is ______________________________. (I telephoned you earlier to arrange this time for an interview.) You have probably received a letter informing you of my visit and describing the Health Study we are conducting for the Upper Ottawa Street Landfill Study Committee, which is funded by the Ontario Ministry of Health. We think you will find the questions interesting and pleasant. Of course, the interview is voluntary and if we should come to any question you don't want to answer, just let me know and we'll skip over it. Your name will not appear on the questionnaire, so let me reassure you that your answers will remain completely anonymous and be kept in the strictest confidence.

____
Place of Interview

____
Record Time Begin

OR ( ) Respondent's home

I.D.'s 201+ (control)
Q're----beige
Consent-blue
Condition Sheets--buff

Resp. I.D.

1. First, how long have you lived in this (house/apartment)?

( ) 1. *less than 1 year*
( ) 2. *1 year, but less than 6 years*
( ) 3. *6 years, but less than 10 years*
( ) 4. *10 years or more*
( ) 7. *Refused*
( ) 8. *Don't know*

2. At present, how many persons are living with you in your household, including yourself?

________________________ *Total*

Do not include visitors who stay less than 1 month.

3. Altogether, how long have you lived in this area, including the time you have lived at this address? *within 30 miles of interview*

________________________ *Years*

eg. Hamilton area includes the Region of Hamilton-Wentworth plus Burlington

4. In the past 15 years, have you lived in a home that was insulated by either asbestos or urea formaldehyde foam insulation?

( ) 1. *yes*
( ) 2. *No*
( ) 7. *Ref*
( ) 8. *DK*

Include only asbestos or Urea - other foam insulation does not count. Consider home insulation -- not simply stove.

5. Is the (home/apartment) where you live now being rented or is it owned by you or a member of your household?

( ) 1. *rented*
( ) 2. *owned (or being bought)*
( ) 7. *Ref*
( ) 8. *DK*

6. Does your drinking water come from ....

( ) 1. the municipal water system,
( ) 2. a private well, or
( ) 3. from some other source?
specify ________________________.
( ) 7. *Ref*
( ) 8. *DK*

This next set of questions is about your health.

Hand Respondent booklet. From time to time I will ask you to turn to certain pages in this booklet. Please try not to turn ahead in the booklet. I'll let you know which page to turn to during the interview.

7. Please turn to Page 1 in this booklet.
In the past 12 months, where have you received most of your health care?

CHECK ONLY ONE

( ) 0. *did not need health care in past 12 months*
( ) 1. *family doctor or specialist including Family Practice Units at Hospitals*
( ) 2. *hospital emergency room*
( ) 3. *hospital outpatient department or hospital clinic*
( ) 4. *at work or industrial clinic*
( ) 5. *someplace else: specify* ____________________
( ) 7. *Ref*
( ) 8. *DK*

8. In the past 12 months, how often did you need health care, not counting going to a dentist?

( ) 0. *never*
( ) 1. *once*
( ) 2. *two, three, or four times*
( ) 3. *five to ten times*
( ) 4. *eleven to twenty times*
( ) 5. *more than twenty times*
( ) 7. *Ref*
( ) 8. *DK*

These next questions refer to your health over the past 2 weeks.

9. During these past 2 weeks, did you stay in bed at all because of your health?

( ) 1. *yes*

( ) 2. *no*
( ) 7. *Ref*
( ) 8. *DK*

10. How many days did you stay in bed for all or most of the day? Include any nights spent as a patient in a hospital.

__________ *days*

11. What was the main health problem which caused you to stay in bed?

____

____

____

____

Ask Everyone

12. During the past 2 weeks, did your health keep you from work at all?

( )	1.	*Yes*	*Go to Q13*
( )	2.	*No*	*Go*
( )	7.	*Ref*	*to*
( )	8.	*DK*	*Q16*

13. How many days did illness or injury keep you from work for all or most of the day during the past 2 weeks?

______ *days*

( ) None - GO TO Q16
( ) Not Applicable

14. On how many of those days lost from work during the past 2 weeks did you stay in bed for all or most of the day?

( ) Not Applicable

______ *days*

15. What was the main health problem which caused you to miss work?

( ) Not Applicable

______

______

ASK EVERYONE

16. Please turn to Page 2 in your booklet. Here is a list of health conditions. I'll read through the list with you. For each one that I mention, just say "yes" if you presently have that particular problem or condition.

Check all that apply.

( ) 1. Anemia
( ) 2. Skin allergies or other skin disorder
( ) 3. Hayfever or other allergies
( ) 4. Asthma
( ) 5. Arthritis or rheumatism
( ) 6. Cancer
( ) 7. Diabetes
( ) 8. Emphysema or chronic bronchitis
( ) 9. Mental disorders including depression, insomnia and so on
( ) 10. High blood pressure or hypertension
( ) 11. Heart disease
( ) 12. Kidney disease or disorder
( ) 13. Stomach ulcer, that is gastric or duodenal ulcer
( ) 14. Digestive disorder
( ) 15. Thyroid trouble or goitre
( ) 16. Recurring migraine headaches
( ) 17. Sight problems or eye disorders -- Including sudden or unusual changes in vision -- not counting normal wearing of glasses.
( ) 18. Any hearing problems or ear disorders -- Including only slight or minor problems
( ) 19. Dental problems
( ) 20. Influenza, that is the flu
( ) 21. Other respiratory ailments or breathing problems

( ) 22. Injury
( ) 23. Serious trouble with the back, spine, legs, hips, arms, shoulders, other joints, or other bones
( ) 24. Is there some other condition you presently have that is not on the list? *Specify* ______________

Interviewer:
Include the presence of any condition, no matter how minor. If in doubt whether to include or exclude, include. Eg. gout, ear infections, need for dental work would be included.

ASK EVERYONE

17. These next questions are about your experience with tobacco and smoking. Do you smoke any of the following daily .... What about ....

a.	pipes?	*( ) 1. yes*	*( ) 2. no*	*( ) 7. Ref*	*( ) 8. DK*
b.	cigars?	*( ) 1. yes*	*( ) 2. no*	*( ) 7. Ref*	*( ) 8. DK*
c.	cigarillos?	*( ) 1. yes*	*( ) 2. no*	*( ) 7. Ref*	*( ) 8. DK*

d. Do you smoke cigarettes daily?

Q 17d only

( ) 1. yes
GO TO Q18

Q 17d only

( ) 2. No GO
( ) 7. Ref TO
( ) 8. DK Q20

18. At what age did you start smoking cigarettes daily?

______
Age

19. About how many cigarettes do you now smoke each day?

______
Number

small package = 20 cigarettes

large package = 25 cigarettes
one carton = 200 cigarettes

GO TO Q24

20. What experience with cigarettes have you had, would you say you never smoke, now smoke occasionally, used to smoke occasionally or you used to smoke daily?

( ) 1. never smoke
( ) 2. now smoke occasionally
( ) 3. used to smoke occasionally
( ) 7. Ref
( ) 8. DK
( ) 9. NA

20a. Did you ever smoke daily?

( )1. yes
Go to Q21

( )2. No
( )7. Ref
( )8. DK
( )9. NA
Go to Q24

( )4. used to smoke daily
Go to Q21

21. At what age did you first start smoking daily?

____
Age

22. At what age did you stop smoking daily? *(the last time)*

____
Age

23. About how many cigarettes did you usually smoke daily?

_____
Number

Small package = 20 cigarettes
Large package = 25 cigarettes
One carton = 200 cigarettes

24. Please turn to Page 3 in your booklet. These next questions are about any experiences you might have had with alcohol. The table on Page 3 might help you answer some of these questions.

In the last 12 months, about how often have you taken at least one drink of beer, wine, liquor or any other alcoholic beverage?

ONE DRINK EQUALS .....

- *one pint bottle of beer (12 ounces)*
- *one small glass of wine (4 ounces)*
- *one shot of liquor or spirits (1-1½ ounces) with or without mix*

A shot with a beer chaser or a double should be counted as 2 drinks.

We are interested in a total picture of the patterns of health of people.

( ) 01. Two or more times a day
( ) 02. Once a day
( ) 03. 4 to 6 times a week
( ) 04. 2 or 3 times a week
( ) 05. about once a week
( ) 06. 2 or 3 times a month
( ) 07. about once a month

To-day is:

( ) 0. Sunday
( ) 1. Monday
( ) 2. Tuesday
( ) 3. Wednesday
( ) 4. Thursday
( ) 5. Friday
( ) 6. Saturday

GO TO Q25

( ) 08. less often than once a month
( ) 09. not at all in the last 12 months
GO TO TOP OF PAGE 10

( ) 77. Ref
( ) 88. DK - Probe - If you had to guess, what would you say?

GO TO Q27

25. Beginning with yesterday, how many drinks did you have on each of the last 7 days:

a. Yesterday?

( ) 1. no drinks
( ) 2. one
( ) 3. two or three
( ) 4. four to seven
( ) 5. eight to eleven
( ) 6. twelve or more
( ) 7. Ref
( ) 8. DK
( ) 9. NA

25. b. Two days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

c. Three days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

d. Four days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

e. Five days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

f. Six days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

g. Seven days ago?

( ) 1. *no drinks*
( ) 2. *one*
( ) 3. *two or three*
( ) 4. *four to seven*
( ) 5. *eight to eleven*
( ) 6. *twelve or more*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

26. During the time you have been an outdoor worker -- and not counting the past 12 months -- would you say you drank more before, less before or about the same as you do now?

( ) 1. *drank more before*
( ) 2. *drank less before*
( ) 3. *drank the same amount*
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

ASK EVERYONE

27. This next question is about your job history since 1953. Starting with your present or most recent job -- either full time or part time, *(Job #1)*, could you tell me about each job you have had and when you held each one.

However, for this question do not include any jobs you might have had where you worked at or near the Upper Ottawa Landfill Site.

But, you should include jobs at other landfill sites. Also, if you did different jobs while working for the same employer, could you tell me the different job titles you had and the years you worked at each one. *(Record each job title and year on a separate line.)*

Interviewer: Probe and fill in chart below.

** *At or Near the Upper Ottawa Site includes the City Works Yard #4, the Fire Fighter Training Complex on Stone Church Road, and the Sewer and Water Works Sheds adjacent to the Upper Ottawa Site only.*

	Example	*Stelco*	*Steelworks*	*Drill press operator*
	Example	*St.Joseph's Hosp.*	*Hospital*	*Registered Nurse*
JOB #	DATES From To	NAME OF COMPANY OR BUSINESS	TYPE OF COMPANY OR BUSINESS	YOUR COMPLETE JOB TITLE
#1	19__ 19__			
#2	19__ 19__			

27. Continued ..

	Example	*Stelco*	*Steelworks*	*Drill press operator*
	Example	*St.Joseph's Hosp.*	*Hospital*	*Registered Nurse*
JOB #	DATES From To	NAME OF COMPANY OR BUSINESS	TYPE OF COMPANY OR BUSINESS	YOUR COMPLETE JOB TITLE
#3	19__ 19__			
#4	19__ 19__			
#5	19__ 19__			
#6	19__ 19__			
#7	19__ 19__			
#8	19__ 19__			
#9	19__ 19__			
#10	19__ 19__			
#11	19__ 19__			
#12	19__ 19__			
#13	19__ 19__			
#14	19__ 19__			
#15	19__ 19__			
#16	19__ 19__			
#17	19__ 19__			

28. Turn to Page 4 in your booklet.
In the past 30 years, that is anytime since 1953, did you work at any job where you came into contact with -- or where you were exposed to -- any of the substances listed on that page. Just give me the number beside the name of the substance.

For this question, do not include anything relating only to the Upper Ottawa Landfill Site.

Interviewer: Mark all substances R. was exposed to first. After the list has been compiled, then ask Q 29 and Q 30 for each substance.

Substance # Name	Q 28 ✓*=yes Exposure?*	Q 29. On which job were you exposed to __. *Record Job# from Q 27.*	Q 30. About how many hours per week were you exposed to ___.
Metal Fumes			
1. Arsenic			
2. Beryllium			
3. Chromium or chromates			
4. Cobalt			
5. Cadmium			
6. Lead			
7. Mercury			
8. Nickel			
9. Tungsten Carbide			
10. Vanadium			
11. Welding			
12. Other metal fumes			
Radiation			
13. Ionizing Radiation (X-rays, uranium, other)			
14. Non-Ionizing radiation (laser/ultraviolet/infrared/diathermy/microwave).			

See Page 10 & 11 for Job #

INTERVIEWER: For clarification only.
We would like to get a total overall picture of any exposures to any substances.

28. Continued ..

Substance *# Name*	Q 28. *✓= yes* *Exposure?*	Q 29. On which job were you exposed to__. *Record Job# from Q 27.*	Q 30. About how many hours per week were you exposed to __.
Paints and Plastics			
15. Bis(chloromethyl) ether			
16. Vinyl chloride			
17. Epoxy resins			
18. Other plastics/ preservatives/resins			
19. Paints/lacquers/ varnishes/glues			
20. inks/ink pigments			
21. Chemical dyes/ pigments			
Fertilizers and Pesticides			
22. Pesticide/ insecticide			
23. Fertilizer chemicals			
24. Herbicide chemicals (24D, 245T, etc.)			
Dusts			
25. Asbestos			
26. Talc			
27. Fibreglass/ rock wool			
28. Coal dust			
29. Silica/quartz			
30. Sand/sand blasting			
31. Ceramic dust			
32. Mineral dusts (diatomaceous earth/ graphite vermiculite/ perlite/molecular sieve or filter/ cracking catalyst			
33. Paper dust/sawdust			
34. Detergent dusts			
35. Other dusts			

See Page 10 & 11 for Job #

28. Continued ..

Substance # Name	Q 28. ✓= yes Exposure?	Q 29. On which job were you exposed to__. Record Job# from Q 27.	Q 30. About how many hours per week were you exposed to .
Oils and Fluids			
36. Transformer/ capacitor fluid			
37. Synthetic coolants/ lubricants/machine oil/cutting oils			
38. Polychlorinated biphenyl (PCB's)			
Petroleum Products			
39. Kerosene			
40. Mineral Spirits			
41. Petroleum distillates/ gasoline			
42. Coal tar/pitch			
43. Asphalt			
Solvents			
44. Varsol			
45. Phenol			
46. Benzene (benzol)			
47. Other solvents including degreasing solvents, cleaning solvents, Trichloroethylene, Perchloroethylene Carbon tetrachloride, Methylethylketone, Methylisobutylketone, methylbutylketone, toluene			
Other Fumes and Gases			
48. Formaldehyde			
49. Freons			
50. Alkalies/caustics			
51. Irritating gases, irritating fumes, fluorine gas, chlorine gas, oxychlorine(pools) oxychloride dust, acid/ acid mists			
52. Asphyxiating gases/methane/ carbon monoxide			
53. Any Other Substance - specify ________________			

See Page 10 & 11 for Job #

31. Please turn to Page 5 in your booklet. This next question is about activities or hobbies you might do when you are not working at a regular job. For example, gardening, farming, repairs or maintenance around the house, car repairs or car maintenance, furniture repairs, housework, hobbies and so on.

During the past 12 months were you exposed to any of the substances listed on Page 5 -- other than at work? Just give me the number beside the name of the substance.

Interviewer: Mark all substances R. was exposed to. After the list has been compiled, then ask Q. 32 for each substance.

For clarification only:
We would like to get a total overall picture of any exposures to any substances.

Substance *# Name*	Q31 ✓ *= yes* *Exposure?*	Q32. About how many hours per month on the average, were you exposed to ____? *During the last 12 months*
Group A		
1. Liquid plastic/fumes		
2. Metal fumes		
3. Plaster dust		
4. Wood/sawdust		
5. Fibreglass		
6. Welding materials		
Group B		
7. Glazes		
8. Liquid enamels		
9. Pastels/chalks		
10. Dyes		
11. Clay dust		
12. Pigments		
Group C		
13. Feathers		
14. Wax		
15. Fixatives		

31. Continued ...

Substance *# Name*	Q31 ✓*= yes* *Exposure?*	Q32. About how many hours per month on the average, were you exposed to ____? *During the last 12 months*
Group D		
16. Oil/Alkyd paints		
17. Acrylic paints		
18. Water based/latex paints		
19. Epoxy paints		
20. Aerosol or spray paints		
21. Lacquer, varnish		
22. Solvents - turpentine, paint thinner, paint removers, other solvents		
23. Gas/oil		
Group E		
24. Acid, caustics		
25. Glues, adhesives, resins		
26. Photography chemicals		
27. Pesticides, insecticides, fungicides, herbicides		
28. Fertilizers		
Other		
29. Specify ____________ ____________ ____________		

INTERVIEWER NOTE FOR PAGES 17-26:
Interviewers are not permitted to offer descriptions or explanations of conditions.

Once a condition is recorded - do not delete information - make notes instead.

33. Now we have some other questions about your health history. For this question, we want you to include anything else you might have already told me about your present health.

Please turn to Page 6 in your booklet.

Here is a list of lung conditions. I'll read through the list with you. For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

	YEAR Symptoms First Noticed				
Lungs	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
1. tuberculosis	19__	19__	19__	19__	19__
2. chronic bronchitis	19__	19__	19__	19__	19__
3. emphysema	19__	19__	19__	19__	19__
4. lung cancer	19__	19__	19__	19__	19__
5. pneumonia	19__	19__	19__	19__	19__
6. asthma	19__	19__	19__	19__	19__
7. difficult or laboured breathing	19__	19__	19__	19__	19__
8. daily cough	19__	19__	19__	19__	19__
9. other lung problem specify ____________ ____________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ____________

34 . Please turn to Page 7 in your booklet.

Here is a list of heart and circulation (cardiovascular) conditions. For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

YEAR Symptoms First Noticed

Heart and Circulation (Cardiovascular)	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
10. heart attack	19__	19__	19__	19__	19__
11. heart failure or congestive heart disease	19__	19__	19__	19__	19__
12. angina	19__	19__	19__	19__	19__
13. heart murmur	19__	19__	19__	19__	19__
14. high blood pressure	19__	19__	19__	19__	19__
15. low blood pressure	19__	19__	19__	19__	19__
16. stroke	19__	19__	19__	19__	19__
17. hardening of the arteries	19__	19__	19__	19__	19__
18. poor circulation in hands or feet	19__	19__	19__	19__	19__
19. other heart or circulation problem specify ____________ ____________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ____________

35. Please turn to Page 8 in your booklet.

Let's do the same with blood and lymph system conditions.

For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

YEAR Symptoms First Noticed

Blood and Lymph System	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
20. infectious mononucleosis	*19*__	*19*__	*19*__	*19*__	*19*__
21. leukemia	*19*__	*19*__	*19*__	*19*__	*19*__
22. multiple myeloma	*19*__	*19*__	*19*__	*19*__	*19*__
23. lymphoma	*19*__	*19*__	*19*__	*19*__	*19*__
24. Hodgkins disease	*19*__	*19*__	*19*__	*19*__	*19*__
25. blood clot (deep vein thrombosis)	*19*__	*19*__	*19*__	*19*__	*19*__
26. anemia	*19*__	*19*__	*19*__	*19*__	*19*__
27. nosebleeds (not from injury)	*19*__	*19*__	*19*__	*19*__	*19*__
28. other abnormal bleeding, *specify part of body (record stomach ulcers later)* *specify:* ______	*19*__	*19*__	*19*__	*19*__	*19*__
29. other blood problem specify ______	*19*__	*19*__	*19*__	*19*__	*19*__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow Pages required. ______

36 . Please turn to Page 9 in your booklet.

Let's do the same with digestive conditions.

For each one that I mention, tell me if you have ever *had that particular condition and the year that you first noticed any symptoms relating to that condition.*

If two or more terms apply to the same condition, just pick the one *you think* best *describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.*

	YEAR Symptoms First Noticed				
Digestive Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
30. cancer of stomach	19__	19__	19__	19__	19__
31. cancer of gallbladder	19__	19__	19__	19__	19__
32. cancer of liver	19__	19__	19__	19__	19__
33. cancer of pancreas	19__	19__	19__	19__	19__
34. cancer of intestine	19__	19__	19__	19__	19__
35. cancer of rectum/anus	19__	19__	19__	19__	19__
36. diabetes	19__	19__	19__	19__	19__
37. gall stones	19__	19__	19__	19__	19__
38. cirrhosis of liver	19__	19__	19__	19__	19__
39. stomach ulcers	19__	19__	19__	19__	19__
40. hepatitis	19__	19__	19__	19__	19__
41. jaundice	19__	19__	19__	19__	19__
42. liver enlargement	19__	19__	19__	19__	19__
43. frequent indigestion	19__	19__	19__	19__	19__
44. alcohol intolerance	19__	19__	19__	19__	19__
45. frequent nausea or vomiting	19__	19__	19__	19__	19__
46. frequent diarrhea	19__	19__	19__	19__	19__
47. frequent constipation	19__	19__	19__	19__	19__
48. loss of appetite	19__	19__	19__	19__	19__
49. loss of weight	19__	19__	19__	19__	19__
50. other digestive condition, *specify* ____________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ________

37 . Please turn to Page 10 in your booklet.

Let's do the same with kidney and bladder conditions.

For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

	YEAR Symptoms First Noticed				
Kidney and Bladder Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
51. cancer of the kidney	19__	19__	19__	19__	19__
52. cancer of the bladder	19__	19__	19__	19__	19__
53. kidney stones	19__	19__	19__	19__	19__
54. unable to urinate	19__	19__	19__	19__	19__
55. painful urination	19__	19__	19__	19__	19__
56. increased frequency of urination	19__	19__	19__	19__	19__
57. decreased frequency of urination	19__	19__	19__	19__	19__
58. other kidney, bladder or urinary problem *specify* ________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ________

38. Please turn to Page 11 in your booklet.

Let's do the same with skin conditions.

For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

YEAR Symptoms First Noticed

Skin Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
59. skin cancer	19__	19__	19__	19__	19__
60. psoriasis	19__	19__	19__	19__	19__
61. eczema	19__	19__	19__	19__	19__
62. open skin sores	19__	19__	19__	19__	19__
63. red, scaly, dry, or itchy skin or rashes	19__	19__	19__	19__	19__
64. unusual acne, hives, boils, warts, cysts	19__	19__	19__	19__	19__
65. white or dark patches on the skin	19__	19__	19__	19__	19__
66. frequent or prolonged bruising	19__	19__	19__	19__	19__
67. any other skin problem, *specify* ________________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ________

39. Please turn to Page 12 in your booklet.

Let's do the same with head and neck conditions.

For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

	YEAR Symptoms First Noticed				
Head and Neck Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
68. cancer of the throat	19__	19__	19__	19__	19__
69. cancer of the nose	19__	19__	19__	19__	19__
70. cancer of thyroid	19__	19__	19__	19__	19__
71. other cancer of head or neck	19__	19__	19__	19__	19__
72. thyroid condition or goitre	19__	19__	19__	19__	19__
73. unusual nose irritation or nasal discharge	19__	19__	19__	19__	19__
74. sinus problems	19__	19__	19__	19__	19__
75. excessive salivation	19__	19__	19__	19__	19__
76. throat infections	19__	19__	19__	19__	19__
77. prolonged, irritated, sore throat	19__	19__	19__	19__	19__
78. swollen or sore gums	19__	19__	19__	19__	19__
79. red, itchy, watery, sore, dry, or inflamed eyes	19__	19__	19__	19__	19__
80. blurred vision even with eyeglasses	19__	19__	19__	19__	19__
81. earaches, ear infections	19__	19__	19__	19__	19__
82. other head & neck condition *specify* ____________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ______

40. Please turn to Page 13 in your booklet.

Let's do the same with nerve and muscle conditions. *For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.*

If two or more terms apply to the same condition, just pick the one you think best describes it. However, you can feel free to mention more than one. For each condition, just say no or give me the year you first noticed any symptoms.

YEAR Symptoms First Noticed

Nerve and Muscle Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
83. brain cancer	*19__*	*19__*	*19__*	*19__*	*19__*
84. epilepsy or seizures	*19__*	*19__*	*19__*	*19__*	*19__*
85. frequent headaches	*19__*	*19__*	*19__*	*19__*	*19__*
86. frequent dizziness or weakness	*19__*	*19__*	*19__*	*19__*	*19__*
87. fatigue, lethargy or drowsiness	*19__*	*19__*	*19__*	*19__*	*19__*
88. problems with balance, coordination, reaction time, clumsiness	*19__*	*19__*	*19__*	*19__*	*19__*
89. tremors, cramps, spasms	*19__*	*19__*	*19__*	*19__*	*19__*
Muscle Weakness: 90. legs or feet	*19__*	*19__*	*19__*	*19__*	*19__*
91. arms, shoulders, hands	*19__*	*19__*	*19__*	*19__*	*19__*
92. back, neck	*19__*	*19__*	*19__*	*19__*	*19__*
Numbness, tingling, prickling, or loss of sensation on: 93. legs or feet	*19__*	*19__*	*19__*	*19__*	*19__*
94. arms, shoulders, hands	*19__*	*19__*	*19__*	*19__*	*19__*
95. back, neck	*19__*	*19__*	*19__*	*19__*	*19__*

Continued on next page

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ______

40 . *Nerve and Muscle Conditions - continued ....*

YEAR Symptoms First Noticed

Nerve and Muscle Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
Pain in:					
96. legs or feet	19__	19__	19__	19__	19__
97. arms, shoulders, hands	19__	19__	19__	19__	19__
98. back, neck	19__	19__	19__	19__	19__
Decreased sense of:					
99. smell	19__	19__	19__	19__	19__
100. taste	19__	19__	19__	19__	19__
101. hearing	19__	19__	19__	19__	19__
Frequent feelings of:					
102. anxiety,depression, trouble sleeping	19__	19__	19__	19__	19__
103. irritability	19__	19__	19__	19__	19__
104. hyperactivity	19__	19__	19__	19__	19__
105. restlessness, trouble sitting still	19__	19__	19__	19__	19__
106. learning disorders, memory or personality changes	19__	19__	19__	19__	19__
107. nervous breakdown	19__	19__	19__	19__	19__
108. any other nerve or muscle condition *specify* ________ ________	19__	19__	19__	19__	19__

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. ________

41. Please turn to Page 14 in your booklet.

READ Here is a list of other health conditions. For each one that I mention, tell me if you have ever had that particular condition and the year that you first noticed any symptoms relating to that condition.

*** Tell me all that apply to you.

YEAR Symptoms First Noticed

Other Health Conditions	*Before 1965 (1)*	*1965 to 1969 (2)*	*1970 to 1975 (3)*	*1976 to 1979 (4)*	*1980 to 1983 (5)*
109. arthritis or rheumatism	*19__*	*19__*	*19__*	*19__*	*19__*
110. hayfever	*19__*	*19__*	*19__*	*19__*	*19__*
111. food allergies	*19__*	*19__*	*19__*	*19__*	*19__*
112. severe problem with colds	*19__*	*19__*	*19__*	*19__*	*19__*
113. other frequent infections	*19__*	*19__*	*19__*	*19__*	*19__*
114. swollen glands	*19__*	*19__*	*19__*	*19__*	*19__*
115. problems with resistance to disease or seem to get sick easily	*19__*	*19__*	*19__*	*19__*	*19__*
116. bone infection	*19__*	*19__*	*19__*	*19__*	*19__*
117. weak bone	*19__*	*19__*	*19__*	*19__*	*19__*
118. other bone or joint disease	*19__*	*19__*	*19__*	*19__*	*19__*
119. cancer not elsewhere reported - *specify location* ____________ ____________	*19__*	*19__*	*19__*	*19__*	*19__*
120. other conditions or complaints not reported above - *specify* 1. ____________	*19__*	*19__*	*19__*	*19__*	*19__*
2. ____________	*19__*	*19__*	*19__*	*19__*	*19__*
3. ____________	*19__*	*19__*	*19__*	*19__*	*19__*

FOR ALL CONDITIONS FILL IN YELLOW CONDITION PAGE LATER.

Enter number of Yellow pages required. _______

Interviewer: *Check that all items on Page 5 are included on*
NOTE *Yellow she[illegible] except #19 - #20 - #22 from P.5*

42. Have you ever had a work related injury?

( ) 1. yes

43. When did the injury happen?

1-____ 2-____ 3-____ 4-____
year year year year

44 . Could you describe the injury?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

( ) 2. no
( ) 7. Ref
( ) 8. DK

45. Have you ever applied for Workmen's Compensation?

( ) 1. yes

46. In what year did you apply and what was the problem?

Year	Problem
19__	____________________
19__	____________________
19__	____________________

GO TO Q 47

( ) 2. no
( ) 7. Ref
( ) 8. DK
( ) 9. NA

GO TO Q 49

47. Did you ever actually receive Workmen's Compensation payments?

( ) 1. yes (or waiting for payments)

48.In what year did you start to receive payments and which problem was it for?

Year	Problem
19__	____________________
19__	____________________
19__	____________________

GO TO Q 49

( ) 2. no
( ) 7. Ref
( ) 8. DK
( ) 9. NA

GO TO Q 49

ASK EVERYONE

INTERVIEWERS: FOR CLARIFICATION ONLY
- Part of the study is to find out if the health of family members is affected by the work setting of another member of the family.

49. Before we go on to the next section, could you turn to Page 15 in your booklet?

What category on this page best describes your current marital status?

( ) 1. *Never married and never lived common-law.*

READ: We can skip this next set of questions since they apply to the health of women who are married to the people we are interviewing.

GO TO TOP OF PAGE 33 AND CONTINUE.

( ) 2. *Presently Married or Living Common-Law* *GO TO Q49a.*	( ) 3. *Presently Separated or Divorced* *GO TO Q50*	( ) 4. *Widowed* *GO TO Q.50*

( ) 7. *Ref.*   ( ) 8. *DK*

49a. Have you ever been separated or divorced?

( ) 1. *yes* *GO TO Q50*	( ) 2. *no* *GO TO Q51*	( ) 7. *Ref* ( ) 8. *DK* ( ) 9. *NA* *GO TO Q51*

50. In what year were you (separated/divorced/widowed)?

__________ *the last time*
year

51. This next set of questions is about any pregnancies your wife or partner, present or past, might have had by you.

Altogether, how many times has your (wife/partner) been pregnant, we want you to consider all pregnancies including those which resulted in live births, still births, miscarriages, or abortions?

( ) 00. *None, never been pregnant*
GO TO Q 58

____
Number of Pregnancies

"0 or None" - GO TO Q 58
"1 or more" - GO TO Q 52

52. Could you tell me in which year each pregnancy ended. Start with the most recent one.

Interviewer: If necessary, allow for a telephone call back to collect information on this section.

In the chart below, record "year ended" for all pregnancies that started, regardless of the final outcome.

Pregnancy #	*Q52 Year Ended*	*Q53 End Result?*	*Q54 Doctor Know? Ask Q54 only for Reason C*	*Q55 4 Weeks Early? Ask Q55 for Reasons A B*
Most Recent # 1	*19__*	*( ) A-- GO TO Q55* *( ) B-- GO TO Q55* *( ) C-- GO TO Q54* *( ) D-- GO TO Q56* *( ) E-- GO TO Q56*	*( ) yes* *( ) no*	*( ) yes* *( ) no*
# 2	*19__*	*( ) A-- GO TO Q55* *( ) B-- GO TO Q55* *( ) C-- GO TO Q54* *( ) D-- GO TO Q56* *( ) E-- GO TO Q56*	*( ) yes* *( ) no*	*( ) yes* *( ) no*
# 3	*19__*	*( ) A-- GO TO Q55* *( ) B-- GO TO Q55* *( ) C-- GO TO Q54* *( ) D-- GO TO Q56* *( ) E-- GO TO Q56*	*( ) yes* *( ) no*	*( ) yes* *( ) no*
# 4	*19__*	*( ) A-- GO TO Q55* *( ) B-- GO TO Q55* *( ) C-- GO TO Q54* *( ) D-- GO TO Q56* *( ) E-- GO TO Q56*	*( ) yes* *( ) no*	*( ) yes* *( ) no*
# 5	*19__*	*( ) A-- GO TO Q55* *( ) B-- GO TO Q55* *( ) C-- GO TO Q54* *( ) D-- GO TO Q56* *( ) E-- GO TO Q56*	*( ) yes* *( ) no*	*( ) yes* *( ) no*

For each pregnancy listed above, complete the chart.

53. Turn to Page 16 in your booklet.
What was the end result of pregnancy #___? *Record above.*

A) Live birth
B) Twins - 1 live and 1 stillborn
C) Miscarriage or spontaneous accidental abortion
D) Intentional Abortion
E) Stillborn (dead at birth)

54. Did the family doctor know about the (miscarriage/abortion)? *Record above*

55. Was the baby born more than 4 weeks earlier than expected? *Record above*

52 - 55 continued ..

Pregnancy #	Q52 Year Ended	Q53 End Result?	Q54 Doctor Know? Ask Q54 only for Reason C	Q55 4 Weeks Early? Ask Q55 for Reasons A B
# 6	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
# 7	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
# 8	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
# 9	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
#10	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
#11	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no
#12	19___	( ) A-- GO TO Q55 ( ) B-- GO TO Q55 ( ) C-- GO TO Q54 ( ) D-- GO TO Q56 ( ) E-- GO TO Q56	( ) yes ( ) no	( ) yes ( ) no

53. Turn to Page 16 in your booklet.
What was the end result of pregnancy #___? *Record above.*

A)	*Live birth*
B)	*Twins - 1 live and 1 stillborn*
C)	*Miscarriage or spontaneous accidental abortion*
D)	*Intentional Abortion*
E)	*Stillborn (dead at birth)*

54. Did the family doctor know about the (miscarriage/abortion)?

55. Was the baby born more than 4 weeks earlier than expected?

56. Did any of your children have any birth defects which were discovered at birth or later in the child's life?

( ) 1. yes (including stillborn)
GO TO Q57

( ) 2. no GO
( ) 7. Ref TO
( ) 8. DK Q58
( ) 9. NA

If R. is not sure if any particular problem is actually a defect,
GO TO Q57

57. Can you tell me what the problem was and the present age of the child? *(or age child would have been)*

________ ______________________________
Age

________ ______________________________
Age

________ ______________________________
Age

58. Has your wife or partner, present or past, ever tried to become pregnant but had trouble conceiving for a long time. In other words, has your (wife/partner) ever been physically unable to become pregnant after one year of trying?

( ) 1. yes, had difficulty
GO TO Q59

( ) 2. no *READ:* We can skip this next section
( ) 7. Ref since the questions are about
( ) 8. DK difficulties in getting
( ) 9. NA pregnant. *GO TO TOP OF PAGE 33*

59. In what year did you first notice this difficulty?

____
year

60. Did your (wife/partner) ever see a doctor because of difficulties in becoming pregnant?

( ) 1. yes GO TO Q61

( ) 2. no ( ) 7. Ref ( ) 8. DK ( ) 9. NA
GO TO Q62

61. Turn to Page 17 in your booklet.
What did the doctor say was the problem?
Just give me the letter beside the category that best describes the doctor's diagnosis.

A ( ) 1. Hormone or gland problem
B ( ) 2. Problem with egg production
C ( ) 3. Problem with the womb or uterus
D ( ) 4. Blocked tubes
E ( ) 5. No reason found
F ( ) 6. Other: specify ____________
( ) 7. Ref ( ) 8. DK ( ) 9. NA

Eg.
- emotional
- trying too hard
are included in the 'other' category (F)

61a. What type of medical treatment did she receive and in what year was that?

If no treatment received, check ( ) and Go to Q. 62

*19*___ ____________________

*19*___ ____________________

61b. Was the treatment successful?

( ) 1. yes *( ) 7. Ref*
( ) 2. no *( ) 8. DK*
( ) 9. NA

62. Did you ever see a doctor because of difficulties in your (wife/partner) getting pregnant?

( ) 1. Yes GO TO Q 63

( ) 2. no ( ) 7. Ref ( ) 8. DK ( ) 9. NA
GO TO TOP OF PAGE 33.

63. Turn to Page 18 in your booklet.
What did the doctor say was the problem?
Just give me the letter beside the category that best describes the doctor's diagnosis.

A ( ) 1. Problem with ejaculation
B ( ) 2. Problem with sperm count
C ( ) 3. Problem with erection
D ( ) 4. Other: specify ____________

( ) 7. Ref ( ) 8. DK ( ) 9. NA

64. What type of medical treatment did you receive and in what year was that?

If no treatment received, check ( ) and GO TO TOP OF PAGE 33.

*19*___ ____________________

*19*___ ____________________

65. Was the treatment successful?

( ) 1. Yes *( ) 7. Ref*
( ) 2. no *( ) 8. DK*
( ) 9. NA

66. Just to be sure that I have everything right, have you ever worked at or near the Upper Ottawa Landfill Site?

(Definition for 'at or near' the Site appears below.)

( )yes--continue

( )no--Go to top of page 34

Please turn to Page 19 in your booklet. Thinking now only about anytime you might have worked at or near the Upper Ottawa Street Landfill Site, did you do any of the jobs listed on this page? *FOR EACH JOB CHECK YES COLUMN.*

Interviewer: Make a note to explain if hours are more than 50.

Job	*Yes (✓)*	*Q67 D A T E S Mo/Yr to Mo/Yr*	*Mo/Yr to Mo/Yr*	*Q68 Average hours per week.*
A. Operator (heavy machinery or general maintenance)	____	______ *to* ______	______ *to* ______	*hrs.* _____
B. Scaleman	____	______ *to* ______	______ *to* ______	*hrs.* _____
C. Security Guard	____	______ *to* ______	______ *to* ______	*hrs.* _____
D. Firefighter	____	______ *to* ______	______ *to* ______	*hrs.* _____
E. Foreman	____	______ *to* ______	______ *to* ______	*hrs.* _____
F. City Yard Worker	____	______ *to* ______	______ *to* ______	*hrs.* _____
G. Superintendent	____	______ *to* ______	______ *to* ______	*hrs.* _____
H. Solidification plant attendant	____	______ *to* ______	______ *to* ______	*hrs.* _____
I. Sewer Man	____	______ *to* ______	______ *to* ______	*hrs.* _____
J. Water Works Man	____	______ *to* ______	______ *to* ______	*hrs.* _____
K. Garbageman - Driver or Loader	____	______ *to* ______	______ *to* ______	*hrs.* _____
L. Truck Driver Not Garbage Truck	____	______ *to* ______	______ *to* ______	*hrs.* _____
M. Salvage Picker	____	______ *to* ______	______ *to* ______	*hrs.* _____
N. Regional Laboratories Tester	____	______ *to* ______	______ *to* ______	*hrs.* _____
O. Other (specify) ______________	____	______ *to* ______	______ *to* ______	*hrs.* _____

67. When did you work as a ________.
Record *MONTH* *and* *YEAR* *for each job above.*

68. On the average, how many hours per week did you spend at each job on the site? *Record in table above.*

At or near the Upper Ottawa Site includes, the City Works Yard #4, the Firefighter Training Complex on Stone Church Road, and the Sewer and Water Works Sheds adjacent to the Upper Ottawa Site only.

INTERVIEWER CLARIFICATION

ASK EVERYONE

There are just a couple of questions left.

69. In what country were you born?

( ) 01. *Canada*
( ) 02. *U.S.A.*
( ) 03. *Britain - England, Scotland, Ireland, Wales*
( ) 04. *Other European Countries, including Russia*
( ) 05. *China, Japan, Hong Kong, Korea - Other Oriental Countries*
( ) 06. *West Indies*
( ) 07. *South/Central America (except West Indies)*
( ) 08. *Middle East - Arabia, Israel*
( ) 09. *India, Pakistan*
( ) 10. *Africa*
( ) 11. *Other: specify* ____________________
( ) 77. *Ref.*
( ) 88. *DK*

70. In what year were you born?

year ______

71. What language did you first learn and use in childhood?

( ) 0. *English*
( ) 1. *French*
( ) 2. *German*
( ) 3. *Italian*
( ) 4. *Ukrainian*
( ) 5. *Polish*
( ) 6. *Other specify* ____________________
( ) 7. *Ref*
( ) 8. *DK*
( ) 9. *NA*

72. What is the last grade of school, college, or university you completed?

( ) 0. *less than grade 8*
( ) 1. *grades 8, 9, 10*
( ) 2. *grades 11, 12*
( ) 3. *grade 13*
( ) 4. *some college/university*
( ) 5. *completed college/university*
( ) 7. *Ref*
( ) 8. *DK*

73. Please turn to Page 20 in your booklet.

Could you tell me which letter on the page corresponds to your present total family income before taxes for 1982?

( ) 01.	A	*Under $ 5,000*	
( ) 02.	B	*$ 5,000 - $ 9,999*	
( ) 03.	C	*$10,000 - $14,999*	
( ) 04.	D	*$15,000 - $19,999*	
( ) 05.	E	*$20,000 - $24,999*	
( ) 06.	F	*$25,000 - $29,999*	
( ) 07.	G	*$30,000 - $34,999*	
( ) 08.	H	*$35,000 - $39,999*	
( ) 09.	I	*$40,000 OR MORE*	
( ) 77.	*Refused*		
( ) 88.	*Don't Know - Probe:*		*If you had to guess, what would you say?*
( ) 99.	*Not applicable*		

Total Family Includes:
- *Respondent*
- *Spouse/partner*
- *Children*

ONLY

This information will help in comparing the the health of people in different groupings.

OBTAIN DOC CONSENT

OBTAIN HOSP CONSENT

SEE Yellow Pages

LEAD TO OBTAIN CONSENT

In order to obtain an accurate and complete health picture, the research study may need to include a review of some existing records.

In order to do this we need your permission.

Hand consent form to Respondent.

Thank you for your co-operation. *Terminate.*

___ ___ ___
Day Month Year
of Interview

☐☐
Interviewer
I.D.

INTERVIEWER IMPRESSIONS

1. Rate degree of co-operation:

   ( ) 1. complete co-operation
   ( ) 2. general co-operation - not fully open on all questions
   ( ) 3. substantial lack of co-operation

2. Rate degree of comprehension:

   ( ) 1. full comprehension
   ( ) 2. generally good comprehension, not complete on some questions
   ( ) 3. substantial difficulties in comprehension, not complete on a good number of questions.

3. Was there anyone else present during the interview?

   ( ) 1. yes - Who? ______________________________
   ( ) 2. no Record any interaction between persons present that might be relevant to the study.

   ____

   ____

4. Check all that apply about the Respondent

   ( ) a. Completely open and candid
   ( ) b. Generally open
   ( ) c. Guarded or suspicious on some answers
   ( ) d. Tended to exaggerate or over report health problems
   ( ) e. Tended to minimize or under report health problems

5. Did you detect anything that might suggest that R. discussed the study with anyone else prior to your interview?

   ( ) 1. yes ( ) 2. no

6. Did R. seem to be concerned with either legal, financial or political issues?

   ( ) 1. yes ( ) 2. no

7. Record anything that seems to you to be important about this R. that would not come through clearly in the responses recorded.

   ____

   ____

   ____

APPENDIX B

Page ___ of ___

REPORTED CONDITION FORM

☐☐	☐☐☐	☐☐☐	____ ____ ____
Abstractor I.D.	Physician I.D.	Patient I.D.	Day Month Year Date of First Entry

This patient has reported having had the following ________ conditions.

TO BE FILLED IN BY OFFICE STAFF ** TO BE FILLED IN BY NURSE ABSTRACTOR

____ ____ ____
Day Month Year
Today's Date

A. Condition # ______	Confirmation Category	Justification of Confirmation Category (make confirmation regardless of dates, but be sure to record dates)
B. ______________ Symptom/Complaint Reported C. ( )1.Symptom ( )2 Diagnosis D. R. reported seeing M.D. ( )1. Yes ( )2. No E. Date Symptoms First Noticed by R. in interview ___/___/___ D M Y	Check only ONE ( )1. ( )2. Confirmed ( )3. ( )4. ( )5. ( )6. Possible ( )7. ( )8. ( )9. Not Confirmed	Describe the evidence to support choice of category. Include supportive and/or contradictory evidence.

A. Condition # ______	Confirmation Category	Justification of Confirmation Category (make confirmation regardless of dates, but be sure to record dates)
B. ______________ Symptom/Complaint Reported C. ( )1 Symptom ( )2 Diagnosis D. R. reported seeing M.D. ( )1. Yes ( )2. No. E. Date Symptoms First Noticed by R. in interview ___/___/___ D M Y	Check only ONE ( )1. ( )2. Confirmed ( )3. ( )4. ( )5. ( )6. Possible ( )7. ( )8. ( )9. Not Confirmed	Describe the evidence to support choice of category. Include supportive and/or contradictory evidence.

APPENDIX C

UNREPORTED CONDITION FORM

Page 1.

☐☐ Abstractor I.D.

☐☐☐ Physician I.D.

☐☐☐ Patient I.D.

On this form, identify those conditions which are found in the medical chart but were not reported by the respondent AND were not used in the verification decisions (categories 1-6) on the complaint verification form labelled Reported Conditions.

If 2 or more conditions listed below seem to be appropriate but are part of the same disease process or syndrome, select the one category which best describes the underlying problem. For example, heart disease complicated by breathing problems would be recorded as heart disease only. On the other hand, heart disease and unrelated hearing problems would be recorded as both heart disease and hearing problems.

For each condition discovered, fill in the chart below.

Record A: Date in chart when last reference is made to this problem.
B: Date when symptoms first noticed by Patient if given (otherwise record date of first chart entry relating to the beginning of this problem).
C: Specify details eg. diagnosis OR major symptoms.

START WITH MOST RECENT VISIT

____ Day ____ Mo. ____ Yr.
Date of LAST chart entry

____ Day ____ Mo. ____ Yr.
Date of Interview

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details
( )1. Anemia	___ ___ ___ D M Y	___ ___ ___ D M Y	

___ ___ ___
Day Mo. Yr.
Date of Interview

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details
( )2. Skin Allergies or other skin disorder	___ ___ ___ D M Y	___ ___ ___ D M Y	
( )3. Hayfever or other allergies	___ ___ ___ D M Y	___ ___ ___ D M Y	
( )4. Asthma	___ ___ ___ D M Y	___ ___ ___ D M Y	

____ ____ ____
Day Mo. Yr.
Date of Interview

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details
( )5. Arthritis or Rheumatism	___ ___ ___ D M Y	___ ___ ___ D M Y	
( )6. Cancer	___ ___ ___ D M Y	___ ___ ___ D M Y	
( )7. Diabetes	___ ___ ___ D M Y	___ ___ ___ D M Y	

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details ___ Day ___ Mo. ___ Yr. Date of Interview
( )8. Emphysema or chronic bronchitis	___ D ___ M ___ Y	___ D ___ M ___ Y	
( )9. Mental disorders including depression, insomnia and so on	___ D ___ M ___ Y	___ D ___ M ___ Y	
( )10. High blood pressure or hypertension	___ D ___ M ___ Y	___ D ___ M ___ Y	

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details ___ Day ___ Mo. ___ Yr. Date of Interview
( )11. Heart Disease	__ D __ M __ Y	__ D __ M __ Y	
( )12. Kidney Disease or Disorder	__ D __ M __ Y	__ D __ M __ Y	
( )13. Stomach ulcer, that is gastric or duodenal ulcer	__ D __ M __ Y	__ D __ M __ Y	

Day Mo. Yr.
Date of Interview

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details
( ) 14. Digestive disorder	D M Y	D M Y	
( ) 15. Thyroid trouble or goitre	D M Y	D M Y	
( ) 16. Recurring migrane headaches	D M Y	D M Y	

___ Day ___ Mo. ___ Yr.
Date of Interview

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details
( )17. Sight Problems or eye disorders--Including sudden or unusual changes in vision--not counting normal wearing of glasses.	___ D ___ M ___ Y	___ D ___ M ___ Y	
( )18. Any hearing problems or ear disorders --including only slight or minor problems	___ D ___ M ___ Y	___ D ___ M ___ Y	
( )19. Dental problems	___ D ___ M ___ Y	___ D ___ M ___ Y	

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details ___ Day ___ Mo. ___ Yr. Date of Interview
( ) 20. Influenza, that is the flu	___ D ___ M ___ Y	___ D ___ M ___ Y	
( ) 21. Other respiratory ailments or breathing problems	___ D ___ M ___ Y	___ D ___ M ___ Y	
( ) 22. Injury	___ D ___ M ___ Y	___ D ___ M ___ Y	

Unreported Condition	A. Last Reference	B. Symptoms First Noted	C. Details ___ ___ ___ Day Mo. Yr. Date of Interview
( )23. Serious trouble with the back, spine, legs, hips, arms, shoulders, other joints, or other bones	___ ___ ___ D M Y	___ ___ ___ D M Y	
( )24. Is there some other condition mentioned in the chart not on the list?	___ ___ ___ D M Y	___ ___ ___ D M Y	

COMPLAINT CONFIRMATION CATEGORIES FOR REPORTED CONDITIONS

CONFIRMED

1. The respondent's reported condition (symptom or diagnosis) is found in the chart.
2. A diagnosis is found in the chart which is consistent with the respondent's reported symptom or diagnosis or subsidiary diagnosis.

POSSIBLE

3. The diagnosis which is found in the chart is the same organ system but only suggestive of the respondent's reported condition.
4. The diagnosis reported by the respondent is not found in the chart, but symptoms found in the chart are consistent with the diagnosis reported by the respondent.
5. The symptoms reported in the chart are suggestive of the respondent's reported condition OR a diagnosis has been ruled out by a physician which is suggestive of the respondent's reported condition.
6. The physician has reported no symptoms AND no diagnoses in the chart for this condition, but lab tests, x-ray reports, etc. are found in the chart which are suggestive of the condition reported by the respondent.

NOT CONFIRMED

7. The respondent's reported condition occured before the medical chart started AND there is no evidence in the chart that the respondent ever had this condition.
8. The physician has recorded no diagnosis or symptoms in the chart which are consistent with or suggestive of the respondent's complaint, AND the chart covers the time period when the respondent says the condition occurred.
9. The chart is so illegible that none of the above categories (i.e. 1 to 8) can be chosen.

APPENDIX

Results of Health Study

done by

Upper Ottawa Street
Residents' Association

November, 1979

November 16, 1979.

ANALYSIS OF DATA:

UPPER OTTAWA DUMP AREA VS CONTROL SURVEY

1. Raw Counts: 24 Signs, Symptoms, or Diseases.

Rules of Acceptance of Counts:

1. All reports counted, whether they are described as being before current residence or not.

2. When individuals in a family were listed as having the condition, each was counted. An unqualified "yes" answer was taken as one count (report).

3. All obvious misdiagnoses excluded.

CONTROL SURVEY		DUMP SURVEY
Total residents: 134		Total residents: 127
1. Skin rash	13	29
2. Asthma	7	7
3. Bronchitis	5	8
4. Emphysema	0	0
5. Frequent Colds	9	32
6. Kidney Problems	1	9
7. Freq. Bladder Inf.	7	11
8. Nervous Breakdown	0	2
9. Hyperactivity	0	1
10. Freq. Sore Throat	4	55
Total residents: 128 (1 family not included)		Total residents: 127
11. Epilepsy	0	2
12. Migraines	8	4
13. Other Headaches (freq)	3	30
14. Nervousness	7	19
15. Mental Retardation	0	0
16. Heart Problems	1	1
17. Arthritis	8	8
18. Bone Problems	1	0
19. Paget's Disease	0	0
20. Gall Bladder	1	1
21. Cancer	0	0
22. Bleeding	4	20
23. Freq. Earaches	3	47
24. Hearing Loss	1	4

On the basis of these crude rates, certain conditions will be excluded from further analysis:

Emphysema
Nervous Breakdown
Hyperactivity
Gall Bladder Disease
Mental Retardation
Bone Problems
Heart Problems
Cancer
Hearing loss
Epilepsy

cont'd.....

Among the remainder, several conditions have similar crude counts between the Upper Ottawa Dump Survey and the Control Survey, or else appear more commonly in the Control Survey. These include:

1. Asthma	2. Bronchitis
3. Migraines	4. Arthritis

These will be divided by report of history prior to residence in survey and where applicable, by crude age ["adult" vs "child"].

1. Asthma:

	Control Survey	Upper Ottawa Dump Survey
% Adults with complaint	1.5% (2)	1.6% (2)
% Children with complaint	3.7% (5)	3.9% (5)
% with complaint previous to current residence	1.5% (2)	3.1% (4)
% with no history of complaint before current residence	3.7% (5)	2.4% (3)

2. Bronchitis:

	Control Survey	Upper Ottawa Dump Survey
% adults with complaint	3.0% (4)	3.9% (5)
% Children with Complaint	0.7% (1)	2.4% (3)
% with complaint previous to current residence	2.2% (3)	3.1% (4)
% with no history of complaint before current residence	1.5% (2)	3.1% (4)

3. Migraines:

	Control Survey	Upper Ottawa Dump Survey
% with complaint before current residence	0.8% (1)	0.8% (1)
% with no history of complaint before current residence	5.5% (7)	2.4% (3)

4. Arthritis:

	Control Survey	Upper Ottawa Dump Survey
% with complaint before current residence	5.5% (7)	1.6% (2)
% with no history of complaint before current residence	0.8% (1)	4.7% (6)

Conclusions: In the case of asthma, bronchitis, and migraines no obvious differences in the "control" and "dump" surveys exist. In view of the very small numbers involved, these will be discarded from further analysis.

In the case of "arthritis" there appears to be a difference in the rates before and subsequent to current residence. However, the diagnostic standard for arthritis was very poor: including aches and pains, gout, muscle cramps, etc. This was particularly evident in the responses from the Upper Ottawa Survey. For this reason it too should be excluded from further analysis.

cont'd.....

This leaves 9 conditions for detailed analysis.

	Condition		Crude Relative Risk	
1.	Skin Rash		2.35	
2.	Frequent Colds		3.75	
3.	Kidney Problems	Combined *	11.61	Combined*2.64
4.	Frequent Bladder Infections		1.66	
5.	Frequent Sore Throats		14.51	
6.	Other headaches, frequent		10.01	
7.	Nervousness		2.75	
8.	Bleeding		5.04	
9.	Frequent Earaches		15.79	

* These two values were combined because the written comments on the questionnaire forms indicates some confusion between them.

Summary: Without further analysis (which in view of the limitations of the data-collection method would be uncalled-for) it appears that complaints of earaches, sore throats and headaches are more frequent among the residents interviewed in the Upper Ottawa Dump Survey, when compared to those interviewed in the Control Survey.

APPENDIX

PRELIMINARY SUMMARY OF THE INHERENT TOXIC PROPERTIES OF SELECTED SUBSTANCES TENTATIVELY IDENTIFIED AT UPPER OTTAWA STREET LANDFILL

Prepared For:

UPPER OTTAWA STREET LANDFILL
SITE STUDY
HAMILTON, ONTARIO

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JANUARY 5, 1983
REVISED FEBRUARY 11, 1983

I. PURPOSE OF THE REPORT

The development of an appropriate investigational method to assess the health of workers once employed at the Upper Ottawa Street Landfill should be guided by a review of the inherent toxic properties of the substances to which they may have been exposed. In this report we present such a review, although it is highly limited and should be used only for assistance in design of the planned health survey. The type of review presented was designed only to provide information on the types of toxic injury or disease that might be expected should exposure to substances at the landfill have occurred at sufficiently high levels and for sufficiently long periods of time. We make no attempt in this report to define either of these exposure parameters.

II. DEFINITION OF TERMS

The key phrase in this review is "inherent toxicity." By this phrase we mean the inherent capacity of a given substance to cause some type of toxic injury or to initiate a disease process, without regard to the conditions of exposure necessary to produce any such effects. Although in the case of a few chemicals very low doses can cause adverse effects, most of the chemicals tentatively identified are hazardous only at high levels of exposure. The actual conditions of worker exposure to the substances reviewed are not known nor can they be reasonably estimated. It is thus not possible to determine, without further analysis, whether any of the substances reviewed actually caused injury or disease. The further analysis will consist of the survey of health status of the workers.

At this stage, the data on inherent toxicity derive entirely from secondary sources. They have been organized according to the various organs of the body that are known to be sites or targets of toxic action (e.g., kidney, lungs, liver, etc.), certain target systems (e.g., nervous system, immune system, etc.), and certain disease states (e.g., cancer, birth defects, etc.). No attempt has been made to identify the specific type of injury or effect that can be produced by these substances, or to assess the severity or degree of reversibility of the effects. (To do so would require extensive consultation of the primary scientific and medical literature.) In some instances, inferences about possible effects were made on the basis of their chemical structures.

III. SOURCES AND ORGANIZATION OF DATA

A substantial amount of sampling and analytical data has been collected at the landfill. Data were collected at different times and by different laboratories. We have examined these data and developed four lists of chemicals from them. The decision to group the chemicals into four groups was based on the media sampled (e.g., air *vs*. soil and water), and on the extent to which a specific group of chemicals can be said to be homogenous with respect to the degree of confidence that can be placed in the analytical findings. Using these criteria, the four lists of chemicals selected for review are the following.

(A) Mann Labs, Soils and Water

Chemicals identified in reports of May 14, August 4, and October 1, 1982 with a "purity" or "fit" value of 800 or greater. For most chemicals, a "fit" value of 800 or more is a good indication that the computer identification is correct, or that the real chemical is structurally related to the one identified. But for some chemicals, for example, those of low molecular weight, a value of 850 or more is needed to ensure reliable identification. By using 800 as a cut off, we are erring on the side of safety to avoid overlooking some hazardous low molecular weight chemicals.

(B) Mann Labs, Air

Chemicals identified in test well gases sampled October 20 and 21, 1982 and in air samples taken on and around the site on November 18, 1982. The degree of confirmation of identity of specific chemicals is uncertain at this time.

(C) Metals, Soil and Water

Metals identified in the Crossley Report, February 1982.

(D) Miscellaneous Data Collected During 1977-1981. Soil, Water, and Air

Specific chemicals identified in other sampling, mostly by the Ministry of the Environment and not appearing in A, B, or C. The degree of confirmation of identity of specific chemicals is uncertain.

The four groups of chemicals are listed in Tables 1, 3, 5, and 7. Some chemicals were grouped as a class of related structural types because many representative members of the class were identified as present and because

important differences in toxicity are either not known or not likely to occur among them. Where differences are known, individual compounds were separated from the class (e.g., n-hexane is treated differently from the other n-alkanes). Each chemical or chemical class was assigned a number to simplify presentation of the inherent toxicity data. Immediately following the table listing a group of chemicals, appears a table containing the inherent toxicities of those chemicals (listed by number). Thus, Table 2 contains the inherent toxicity data on chemicals listed in Table 1, and coded as in Table 1. Tables 3 and 4, Tables 5 and 6, and Tables 7 and 8 are related in this same way.

The sources of inherent toxicity data were the following:

American Conference of Governmental Industry Hygienists, Inc. 1981. Documentation of the Threshold Limit Values. 4th Edition. ACGIH. Cincinnati, Ohio

Clayton, G.D. and Clayton, F.E. 1982. Patty's Industrial Hygiene and Toxicology. Vols. 2A, 2B, and 2C, Third Revised Edition. John Wiley and Sons, Inc. New York

Doull, J., Klaasen, C.D., and Amdur, M.D. 1980. Casarett and Doull's Toxicology. 2nd Edition, McMillan Publishing Co., Inc. New York

National Research Council, Safe Drinking Water Committee, 1977. Drinking Water and Health. National Academy of Sciences Washington, D.C.

National Research Council, Safe Drinking Water Committee, 1980. Drinking Water and Health, Vol. 3 National Academy Press, Washington, D.C.

NIOSH, 1979. Registry of Toxic Effects of Chemical Substances. U.S. Department of Health and Human Services. National Institute for Occupational Safety and Health. Cincinnati, Ohio 45226

As previously noted, the experimental conditions under which these various forms of toxicity have been observed are not noted because they are not relevant to the purpose of this review.

IV. RESULTS

The results of this review are readily discerned in Tables 2, 4, 6, and 8. Before drawing conclusions from the results, one further qualification should be noted. The abundance of toxicity data in certain areas (e.g., eye irritation) and their relative lack in other (e.g., toxic effects on the immune system) are in part due to the differences in the availability of methodology with which different types of data are collectecd. Thus, toxicologists have devoted considerable attention to certain types of toxicity, and have accordingly developed appropriate experimental methodology, and have paid much less attention to other areas. The extent to which this artifact of testing influences the data collected in Tables 2, 4, 6 and 8 can not be estimated, but it is surely a factor.

Nonetheless, the data shown do represent the extent of knowledge, and can be used to guide the planned health survey. Moreover, the data collected in these tables adequately demonstrate the need for a comprehensive health survey of workers who might have been exposed to many of the substances listed. It is probable that certain types of toxicity should be more thoroughly investigated than others, but the wide variety of likely effects suggests the need for a comprehensive evaluation. It should be noted that even effects for which the evidence is relatively meagre (e.g., effects on several of the endocrine glands), may nevertheless be important if the substances capable of producing them act at relatively low doses.

We finally reemphasize that the data presented in this review serve no purpose but to guide the planned health surveys, and do not reveal any information about actual health risk.

TABLE 1

CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN WATER AND SOIL SAMPLES

1. Aliphatic alcohols, C_6-C_{19}
2. Aliphatic aldehydes, C_6-C_{10}
3. Aliphatic esters
4. Aliphatic ethers C_4-C_{11}
5. Alkenes C_4-C_{10}
6. Alkyl benzenes
7. Alkyl ketones, C_3-C_9
8. Aniline
9. Benzene
10. Benzene acetaldehyde, α-methyl-
11. Benzene butanoic acid, 2,5-dimethyl-
12. Benzene methanol, α, α-dimethyl
13. Benzene propanoic acid
14. Benzoic acid
15. Benzoic acid, 3,4-dimethyl
16. Benzoic acid, 4-(1,1-dimethylethyl)-
17. Benzothiazole, 1-(methylthio)-
18. 2(3H)-Benzothiazolone
19. Benzo[b]thiophene
20. Bicyclic aliphatics

TABLE 1

CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN WATER AND SOIL SAMPLES

(Continued)

21. Butane, 2-azido-2,3,3-trimethyl-
22. 9H-Carbazole
23. Carbon disulfide
24. Carboxylic acids (simple)
25. Cycloheptatriene
26. Cyclohexane, methyl
27. Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1α, 2α, 5β
28. Cyclohexanone, 3,3,5-trimethyl-
29. Cyclohexene, 3-methylene-6-(1-methylethyl)-
30. 2-Cyclohexen-1-ol
31. 2-Cyclohexen-1-one
32. 2-Cyclohexen-1-one, methylated (3-, 3,4,5-, 3,5,5-)
33. Cyclooctane, 1,4-dimethyl, trans-
34. Cyclopentane, 1,2-dimethyl-, cis-
35. Cyclopentene, 1-ethenyl-3-methylene-
36. Cyclopropane, 1-butyl-1-methyl-2-propyl-
37. Cyclopropane, 1,1-dibromo-2-chloro-2-fluoro-
38. Dibenzofuran
39. Dibenzofuran, 4-methyl-

TABLE 1

CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN WATER AND SOIL SAMPLES

(Continued)

40. 1,3,-Dioxane
41. 1,4-Dioxane
42. 1,4-Dioxolane, 4-methyl
43. Dodecanamide
44. Ethanone, 1-(2-methyl cyclopropyl)-
45. Ethene, 1,2-dichloro-,(z)-
46. Ethene, 1,1-dichloro-
47. Ethene, trichloro-
48. Tetrahydrofuran and derivs.
49. Guanidine
50. Hexane
51. Hydrazine, 1,2-dimethyl
52. Hydroxylamine, O-decyl-
53. Isoquinoline
54. 1(2H)-Isoquinolinone
55. Methane, thiobis-
56. Morpholine, 4-acetyl-
57. Morpholine, 3,5-dimethyl-4-nitroso-
58. Morpholine, 4, 4'-methylenebis

TABLE 1

CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN WATER AND SOIL SAMPLES

(Continued)

59. Napthalene, decahydro-2-methyl-
60. Nitriles (butane and propane)
61. Nonanamide
62. Oxazolidinone, 3-(2-hydroxypropyl)-5-methyl-
63. PAH's
64. PCBs
65. 2-Pentene, 5-bromo-2,3-dimethyl-
66. Phenol
67. Alkyl phenols
68. Phthalate, di(2-ethyl hexyl)-
69. Phthlates - others
70. Picoline, 6-nitro-
71. Piperidinone
72. 2H-Pyran-2-one
73. Pyridine, 3-(1-methyl-2-pyrrolinyl)-(s)- [nicotine]
74. Pyrrolidinone, 1-methyl-
75. Thiophene, tetrahydro-, 1,1-dioxide

TABLE 2

POSSIBLE TARGET SITES AND EFFECTS OF CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN WATER AND SOIL SAMPLES FROM UPPER OTTAWA STREET LANDFILL

EFFECTS	CHEMICALS
Eye irritation	1, 2, 3, 4, 5, 6, 7, 9, (10), (11), (12), (13), (14), (15), (16), 23, 24, 25, (27), (28), (29), (30), (31), 32, (35), 41, 46, 47, 50, 51, 55, 56, (59), 63, 66, 67, 68, (69), (70), (71), 73, (74)
Eye damage	63
Skin irritation	1, 2, 3, 4, 5, 6, 7, 9, (10), (11), (12), (13), (14), (15), (16), 23, 24, 25, 26, (27), (28), (29), (30), (31), 32, (33), (34), (35), 41, 46, 47, (48), 50, 51, 56, (59), 63, 66, 67, 68 (69), (70), (71), 73
Skin damage (chloracne)	64
Allergic sensitization	9, (17), (18), 23, (51), 63, 73
Upper Respitatory tract irritation	1, 4, 5, 6, 23, 24, (28), 32, 41, 46, 50, (56), 63, 66, (69), (70), (74)
Lung damage	46, (59), 64, 66, 67, (70), (74)
Liver damage	1, 3, 7, (26), (27), 41, (44), 45, 46, (48), (51), (56), (59), 63, 64, 66, 67, (70), (74)
Porphyria	64
Kidney damage	1, 7, (26), 41, 46, (48), (56), (59), 66, 67, (70), (74)
Adrenal damage	46
Central nervous system depression	6, 9, (28), (29), (30), (31), 32, (44), 45, 46, 47, 48, 50, 66, 67, (70), (71), 73, (74)
Narcosis	1, 2, 3, 4, 5, 6, 7, 9, (28), (29), 32, (34), (44), 45, 46, 47, 48, 50, (70)
Central nervous system damage	1, (21), 23, 51, 66, 67
Peripheral nervous system damage	9, 23, 50, 66
Blood cell disorders	9, 23, 63, 73
Hemolysis	(51)
Anoxia	60
Methemoglobinemia	8
Immunological effects	9, 47, 64
Spleen damage	67
Thymus damage	64
Cardiovascular effects	(5), 7, 9, (21), 23, 46, 47, 48, 66, 67, 73, (74)
Gastrointestinal effects	23, (56), 64, 66, 67, (70), 73, (74)
Pancreatic damage	67
Endocrine disorders	23
Bone disorders	
Reproductive effects	64
Embryotoxicity	5, 46, 63, 64, 73
Teratogenicity	63, 64, 73
Mutagenicity	46, 47, (51), 63, 73
Carcinogenicity	8, 9, 41, 46(?), 47, 51, (57), 58(?), 63, 64, 68
Tumor promotion	66

NOTES:

a. Parentheses ( ) indicate that no data was found for the particular chemical but closely related chemicals have the effect noted. A question mark (?) indicates that the evidence for a particular effect is not conclusive.

b. Where classes of chemicals are indicated, not all members of the class cause all the effects noted.

TABLE 3

CHEMICALS TENTATIVELY IDENTIFIED BY MANN LABS IN AIR SAMPLES

1. Aliphatic alcohols

5. Alkenes

6. Alkyl benzenes

7. Alkyl ketones

9. Benzene

76. Chloroform

77. "Dichlorobenzene"

78. "Dichloroethane"

79. "Dichloroethylene"

80. Dichloromethane

81. Dimethyl disulfide

82. Dimethyl sulfoxide

41. 1,4-Dioxane

50. Hexane

83. Indene and methyl indene

84. Naphthalene

85. Styrene

86. Tetrachloroethylene

48. Tetrahydrofuran

87. "Trichloroethane"

47. Trichloroethylene

NOTE: For chemicals 77, 78, 79 and 87, the particular isomer present was not identified. In table 4, the effects listed for these chemicals are composites of the effects of the different isomers.

TABLE 4

POSSIBLE TARGET SITES AND EFFECTS OF CHEMICALS TENTATIVELY IDENTIFIED IN AIR BY MANN LABS

EFFECTS	CHEMICALS
Eye irritation	1, 5, 6, 7, 9, 76, 77, 78, 79, 80, 82, 41, 50, 84, 85, 86, 87, 47
Eye damage	84
Skin irritation	1, 5, 6, 7, 9, 76, 77, 78, 79, 80, 82, 41, 50, 83, 84, 85, 86, 48, 87, 47
Skin damage (chloracne)	
Allergic sensitization	
Upper Respitatory tract irritation	1, 5, 6, 77, 78, 41, 50, 83, 84, 85, 86, 48
Lung damage	78, 79
Liver damage	1, 7, 76, 77, 78, 79, 80, 41, 83, 86, 48, 87
Porphyria	77
Kidney damage	1, 7, 76, 77, 78, 79, 41, 83, 86, 48, 87
Adrenal damage	78
Central nervous system depression	6, 9, 76, 78, 79, 80, 41, 83, 86, 48, 87, 47
Narcosis	1, 5, 6, 7, 9, 76, 78, 79, 80, 50, 48, 87, 47
Central nervous system damage	1
Peripheral nervous system damage	9, 50
Blood cell disorders	9, 77, 84
Hemolysis	84
Anoxia	
Methemoglobinemia	
Immunological effects	9, 47(?)
Spleen damage	83
Thymus damage	
Cardiovascular effects	5, 7, 9, 78, 79, 48, 47
Gastrointestinal effects	76, 78, 86
Pancreatic damage	
Endocrine disorders	
Bone disorders	
Reproductive effects	
Embryotoxicity	5, 76, 79, 80, 86
Teratogenicity	81
Mutagenicity	78, 79, 47
Carcinogenicity	9, 76, 78, 41, 85(?), 86, 87, 47
Tumor promotion	

TABLE 5

METALS TENTATIVELY IDENTIFIED IN CROSSLEY REPORT

88. Aluminum

89. Arsenic

90. Cadmium

91. Chromium

92. Copper

93. Iron

94. Lead

95. Manganese

96. Nickel

97. Zinc

TABLE 6

POSSIBLE TARGET SITES AND EFFECTS OF METALS TENTATIVELY IDENTIFIED IN CROSSLEY REPORT

EFFECTS	CHEMICALS
Eye irritation	
Eye damage	
Skin irritation	91, 97
Skin damage (chloracne)	
Allergic sensitization	91, 95, 96
Upper Respitatory tract irritation	90, 91
Lung damage	90, 91, 93, 96
Liver damage	92, 96, 97
Porphyria	
Kidney damage	90, 92, 94, 96
Adrenal damage	
Central nervous system depression	
Narcosis	
Central nervous system damage	92, 94, 95
Peripheral nervous system damage	89, 94
Blood cell disorders	89, 91, 94, 97
Hemolysis	
Anoxia	
Methemoglobinemia	
Immunological effects	94(?)
Spleen damage	92
Thymus damage	
Cardiovascular effects	94, 96
Gastrointestinal effects	88, 89, 90, 91, 92, 93, 96, 97
Pancreatic damage	
Endocrine disorders	89, 94
Bone disorders	88, 90
Reproductive effects	90, 94, 96, 97
Embryotoxicity	94
Teratogenicity	89
Mutagenicity	
Carcinogenicity	89, 90, 91, 96
Tumor promotion	

TABLE 7

CHEMICALS TENTATIVELY IDENTIFIED IN EARLIER SURVEYS NOT APPEARING IN TABLES 1-6

98. BHC and Lindane
99. Carbon tetrachloride
100. Dieldrin
101. Endrin
102. Heptachlor epoxide

TABLE 8

POSSIBLE TARGET SITES AND EFFECTS OF CHEMICALS TENTATIVELY IDENTIFIED IN EARLIER SURVEYS NOT APPEARING IN TABLES 1-6

EFFECTS	CHEMICALS
Eye irritation	
Eye damage	
Skin irritation	
Skin damage (chloracne)	
Allergic sensitization	
Upper Respitatory tract irritation	
Lung damage	100
Liver damage	98, 99, 100, 101, (102)
Porphyria	
Kidney damage	98, 99, 100, 101
Adrenal damage	101
Central nervous system depression	98, 99
Narcosis	99
Central nervous system damage	98, 100, 101, (102)
Peripheral nervous system damage	
Blood cell disorders	98
Hemolysis	
Anoxia	
Methemoglobinemia	
Immunological effects	
Spleen damage	
Thymus damage	
Cardiovascular effects	
Gastrointestinal effects	99
Pancreatic damage	
Endocrine disorders	
Bone disorders	
Reproductive effects.	100, 101
Embryotoxicity	99, 100, 101
Teratogenicity	100, 101
Mutagenicity	
Carcinogenicity	98, 99, 100 (102)
Tumor promotion	

ADDENDUM TO PRELIMINARY SUMMARY OF THE INHERENT TOXIC PROPERTIES OF SELECTED SUBSTANCES TENTATIVELY IDENTIFIED AT UPPER OTTAWA STREET LANDFILL

Prepared For:

UPPER OTTAWA STREET LANDFILL
SITE STUDY
HAMILTON, ONTARIO

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The following is intended as an addition to our report of January 5, 1983, and the chemicals and tables are numbered to follow those in the main report. All of the general considerations regarding the purpose and scope of that work apply to the data presented here. In particular it must be reemphasized that the "effects" listed are generally those that have been reported under rather extreme conditions of exposure. The purpose of these tables is to help guide the planned health survey to ensure that the survey is designed to detect adverse effects of the types that may have been caused by chemicals tentatively identified at the landfill.

Tables 9 and 10 list additional chemicals and possible effects of those chemicals that have been tentatively identified by Sciex in air samples before and after attempts to burn gases being vented from the landfill, and that do not apear in Tables 1-8.

TABLE 9

ADDITIONAL CHEMICALS TENTATIVELY IDENTIFIED IN AIR BY SCIEX

103. Acrylic acid
104. Benzaldehyde
105. Benzaldehyde, methyl-
106. Carbaryl
107. Methane, nitro-
108. Pyridine, methyl-
109. Styrene

TABLE 10

POSSIBLE TARGET SITES AND EFFECTS OF CHEMICALS TENTATIVELY IDENTIFIED IN AIR BY SCIEX

EFFECTS	CHEMICALS
Eye irritation	103, 104, 105, 108, 109
Eye damage	103
Skin irritation	103, 104, 105, 108, 109
Skin damage (chloracne)	
Allergic sensitization	103, 104
Upper Respitatory tract irritation	103, 107, 108, 109
Lung damage	107
Liver damage	106, 107
Porphyria	
Kidney damage	103, 106, 107
Adrenal damage	
Central nervous system depression	104, 107, 108, 109
Narcosis	108, 109
Central nervous system damage	
Peripheral nervous system damage	
Blood cell disorders	
Hemolysis	
Anoxia	
Methemoglobinemia	
Immunological effects	
Spleen damage	
Thymus damage	
Cardiovascular effects	
Gastrointestinal effects	103
Pancreatic damage	
Endocrine disorders	
Bone disorders	
Reproductive effects	
Embryotoxicity	103, 106(?)*
Teratogenicity	103, 106(?), 108(?)
Mutagenicity	105(?), 108(?)
Carcinogenicity	
Tumor promotion	

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* A question mark (?) indicates that the evidence for an effect is not conclusive.

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